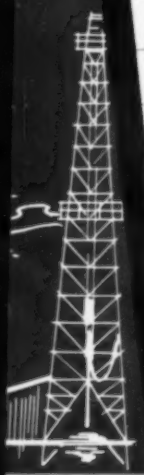
the OIL AND GAS JOURNAL

OCTOBER 14, 1957

Memo to Drilling Contractors -

28 pages on Blowout Preventers
16 pages on Mud Pumps
20 pages on Active Drilling Areas
starting p. 123



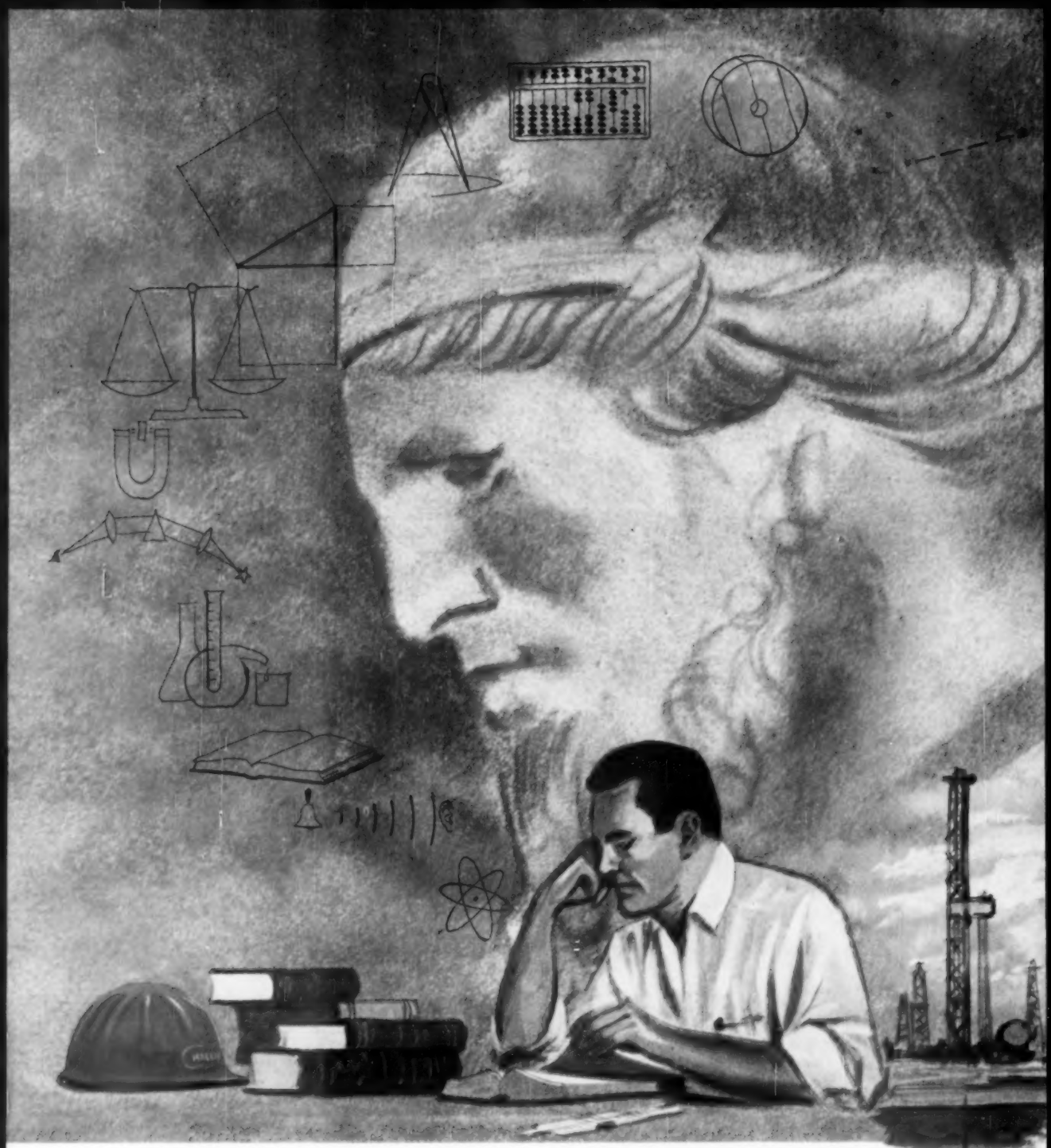
L.P.G. Underground Storage:

Journal survey shows capacity jumped 35 per cent last year, now totals 33,887,000 bbl. p. 101

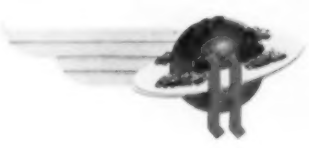
To stay competitive:

West Coast refiners must spend $40 million by 1965

p. 106



knowledge



Ever since the dawn of civilization, trails of progress have been blazed by men of knowledge. The path of petroleum is no exception. Built by the step-by-step accumulation of knowledge, the path of oil leads from deep in the earth's crust to the world above, providing energy for the needs of mankind.

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the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
Oct. 14, 1957

Russia's Sputnik satellite could affect U. S. refiners:

The Soviet jump into outer space likely will force the U. S. to step up the timetable of American satellite and missile programs. This will change the picture for military petroleum needs.

Missiles require very little petroleum fuels. Some models are known to burn kerosine in their initial stages. But the lion's share of missile propulsion comes from higher energy fuels based on boron or other elements.

But more important: Missiles will cut into the military-fuel market. Medium-range ballistic missiles will make inroads on the interceptor-type jet plane. The intercontinental missile will do the same for long-range bombers.

These developments were expected to change the fuels program after 1962 (OGJ, Oct. 7, p. 95). Now this change could come earlier.

The new jet airliner market may offset military losses.

Airline management has just been told what the tremendous fuel appetite of jets will mean: Need for pinpoint planning to avoid calamitous losses.

A Trans World Airlines study shows the Boeing 707 consumes 700 gal. of kerosine per hour idling on ground and nearly 1,800 gal. per hour in flight.

Other cost factors: $900 per hour to operate a jet, up 236 per cent over Constellation. Old DC-3 cost only $75 an hour. The overhaul cost will run $25,000 to $35,000 per trip to the shop.

Here's what the average West Coast refiner faces:

He must double capacity and expand other units in next 8 years at $40.3-million cost if he wants to stay competitive.

A U.O.P. research team reports the average West Coast refiner will need to double basic crude distillation, more than double cat cracking and reforming, and triple hydrogen treating and alkylation. He'll need to add isomerization if he hasn't done so (p. 106).

L.P.G. underground storage is up 34½ per cent in a year.

Latest Journal survey shows present capacity is 33,887,000 bbl., up 11,691,510 bbl. from last year. It's a record gain.

And end of storage expansion is not in sight. Companies already have plans for projects that will lift capacity to 57,068,000 bbl. (p. 101).

The oil industry has a stake in several suits on the current docket for new term of Supreme Court.

Issues coming up for a decision: The offshore boundaries of the gulf states, extent of FPC's power to control sales of casing-head and wellhead gas, good faith as a defense against charges of illegal price cutting, and authority of states to order minimum prices for natural gas.

Oil is becoming the most investigated industry in the country.

A third federal grand jury now is being set up to look into fuel-oil distribution practices. The inquiry was ordered by the federal District Court in Washington, D. C., on request of the Attorney General's office.

More than a dozen firms selling in the Washington area are expected to be brought before the jurors.

Other grand jury probes: Alexandria, Va., panel has been at work for several months looking into pricing practices of major oil companies. A South Bend, Ind., jury is investigating price wars in the Midwest.

The economy of government oil purchases abroad is under fire.

Independent refiners point out these factors: Both state and federal governments lose tax revenue from the lost sales. If all angles are considered, buying from U. S. refineries is just as economical.

Domestic producers now are joining refiners in the fight. They accuse the Defense Department of flouting both the Buy American Act and the new import-control program in buying 8 million barrels of jet fuel from Caribbean refiners.

Oil men dealing with Washington have a new face to learn.

He's Royce A. Hardy, Jr., Nevada mining man, who has been sworn in as chief of the Interior Department's oil programs. He will direct activities of the Office of Oil and Gas, Bureau of Mines, and the Geological Survey.

New entry in small-car field will be Studebaker-Packard.

Company will introduce the German-built Gogomobile to retail from $1,000 to $1,400. It gets 38 to 48 miles per gallon and has a two-stroke, fan-cooled, rear-mounted engine producing 17 hp.

Turbines look good for helicopters even if they've failed to crack the automotive field.

An almost "explosive growth" in helicopter sales in 1961-65 is predicted by D. R. Berlin of Vertol Aircraft. He bases his claims on improved operating characteristics of planes powered with turbine engines.

Massachusetts has a tax-refund gimmick to stimulate traffic on its new east-west turnpike.

It refunds state gasoline taxes to turnpike users.

Plan works like this: Motorist gets receipt on leaving turnpike. It shows number of turnpike-miles driven. This plus receipt from a Massachusetts gasoline station showing he bought gasoline within 3 days before his turnpike trip are sent twice a year to state excise bureau.

A refund based on 15 miles per gallon for cars and 5 miles per gallon for trucks is returned by check. The state tax is 5.5 cents per gallon. It means a refund for trucks equaling 25 per cent of the toll charge.

Refiners will want to watch this: New pelleted kaolin catalyst for moving-bed cat cracking units is due a thorough testing this month.

Testing place will be Commonwealth's new Houdriflow unit which is going on stream in Puerto Rico.

Kaolin has been added to several other moving-bed cat units to replace loss. But this is first instance of a complete fill with the new catalyst type.

Just for an idea how big tankers are getting consider these:

One of the 106,500-ton supertankers Bethlehem Steel is building for Onassis interests is larger than the combined 132-ship Spanish Armada.

The 11 supertankers being built for Universe Tankships in Japan add up to 1,126,490 tons and can haul more than 8 million barrels of oil at one time. That's more oil than the U. S. is producing in a day.

Europe may act to build up its storage capacity for a crisis.

With lessons learned from the Suez trouble. 17 member nations in Organization for European Economic Cooperation are working on plans to provide storage for full month supply of crude. When Suez was closed, Europe felt oil pinch immediately because little storage was available.

O.E.E.C. delegates plan to ask member nations and private industry to spend $60 to $75 million on the new storage facilities.

A new terminal is supplying the oil needs of military and DEW network facilities in Canada and the Arctic.

The $2-million depot is located at Churchill, Man., on the northwest shores of Hudson Bay. First shipment of 4,000,000 gal. of diesel oil has just arrived.

The terminal is planned solely for military use but easily could be doubled or tripled in size to supply civilian needs as well.

First wildcat in Venezuela's Gulf of Paria will be started this month. Operator is new company formed by syndicate of U. S. oil firms.

Test will be drilled 6 miles offshore in 90 ft. of water and 10 miles from offshore production in Trinidad's Soldade field. A Loffland Brothers' drilling tender will be used.

Paraguay has confirmed a big concession will go to Pure Oil.
The 14.5-million-acre grant is in the Chaco Boreal region bordering productive areas in both Argentina and Bolivia. Half interest in the concession is held by Williams Brothers.

Oklahoma has a wildcat scheduled for 24,000 ft.
At that depth the well will be the world's deepest. Object will be the Ordovician pay in Oklahoma's biggest unproductive structure, the Fort Cobb anticline.
Kenneth A. Ellison & Associates of Oklahoma City and three other companies own the 40,000-acre block in the Anadarko area. Howell, Holloway, & Dowell, Dallas, will do the drilling (p. 105).

Rocky Mountain oil men are watching two Wyoming wildcats.
Both are in remote areas of the Powder River basin, second largest basin in the U. S. and one of the nation's great untested areas.
The wells are: Lacy Armour's 1 Kendrick Cattle Co., 4 miles south of Montana line in Campbell County. Test is 50 miles from production and will seek the Shannon to about 5,600 ft. And Farmers Union 1 State-A on Ash Creek in Sheridan County. It is 28 miles from production and will go to 8,700 ft.

High-pressure, gas-injection project finally is getting under way in Headlee Devonian field of West Texas.
Texas Railroad Commission approved unitization and also plans of Texas Gulf Producing for gas injection. The unit is expected to expand as other operators join (p. 116).

FPC is tightening its control over gas sales of independent producers. Its move against Union Producing Co. may be a test.
Agency is threatening an enforcement suit in federal courts and may send the matter to Justice Department for further action if Union doesn't put up a good case at a hearing next month.
Union claims there is continuous flow of gas from its wells through pipelines of an affiliate to the customer. That's why the company has not filed for rate schedules and sales permits.

Shell plans a new crude line from Delta area of South Louisiana to its Norco, La., refinery.
Other producers in the area may join in building the 100-mile, 16 or 20-in. line. Offshore fields in Delta area now produce about 80,000 bbl. daily. Shell is one of the major operators.

The new Mediterranean pipeline is back in the news.
Iran's Shah says he will ask parliament for permission to sign a pipeline agreement with a New York investment firm.
Plans call for a 1,000-mile, big-inch line from Alborz field in Central Iran to Iskenderun, Turkey. The $500-million project hinges on proving huge reserves exist in the Qum area. No oil money is involved in the pipeline at this time (p. 120).

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How To Get Your Money's Worth From Your Mud Pumps 123

By J. O. Scott

A special 16-page report, designed for day-to-day rig operation, which shows how cost can be reduced while operating efficiency is increased.

The pump should have good suction to make sure it will deliver its rated amount of mud. At the same time fluid-end knocks will be either greatly curtailed or eliminated. On the other side of the pump a pulsation dampener is used to smooth out pressure surges.

Once the pump is set up and operating, a planned program for inspection and maintenance is needed. Parts should be replaced only after the crews are briefed on proper method. Power end should be properly lubricated and the oil changed when needed.

These and many other points are explained in detail in this section.

High-Pressure Drilling and Blowout Prevention 139

By Frank S. Bell

A special 28-page report made available to the Journal by Shell Oil Co.

The costs of high-pressure drilling can be cut in three ways: (1) Preventing blowouts, (2) Preventing lost circulation, and (3) Eliminating addition of weight material to the mud when it isn't necessary.

The blowout costs a great deal of money and may even claim a human life. Lost circulation is expensive due to loss in mud and rig time. Adding weight material to mud unnecessarily also costs money.

This report shows how all three costs can be kept down.

Drilling Data on Active Fields 167

By Norman S. Morrisey

Here the Journal's annual drilling survey gives the latest information on contract drilling costs, casing programs, bit requirements, pay zones, completion practices, total days required to drill an average field well, etc.

The data are for typical field wells in each area listed. The report covers both the United States and Canada.

TECHNOLOGY—OPERATION

Converting a Pipeline from Crude to Products Service 219

By Harold Slief

Continental Pipe Line Co. has completed the conversion of 100 miles of 6-in. pipeline between Wichita Falls and Saginaw, Tex., from crude to products service. The cleaning operation proved to be highly efficient.

Hydrogen Blistering in Cat-Cracker Gas Plants 222

By R. T. Effinger

Corrosion of this type can be combated by improving feed preparation and controlling catalyst quality. The attack is limited to places where water is present, where sulfides are present, and where either high or low pH values prevail.

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Pipeline Patrol: Construction Report 229

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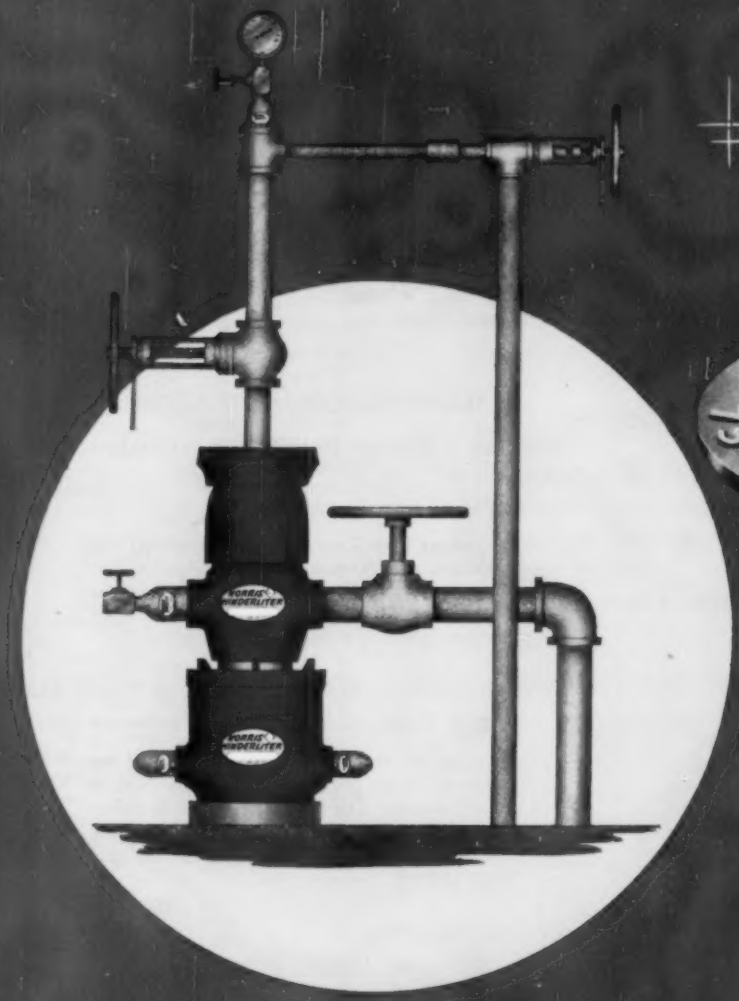

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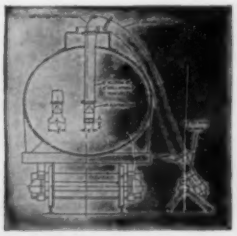

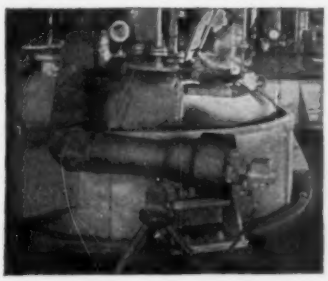

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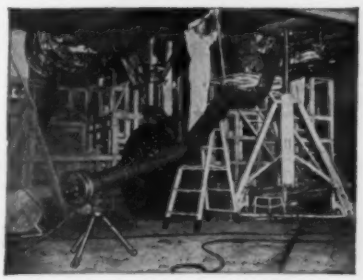
Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.



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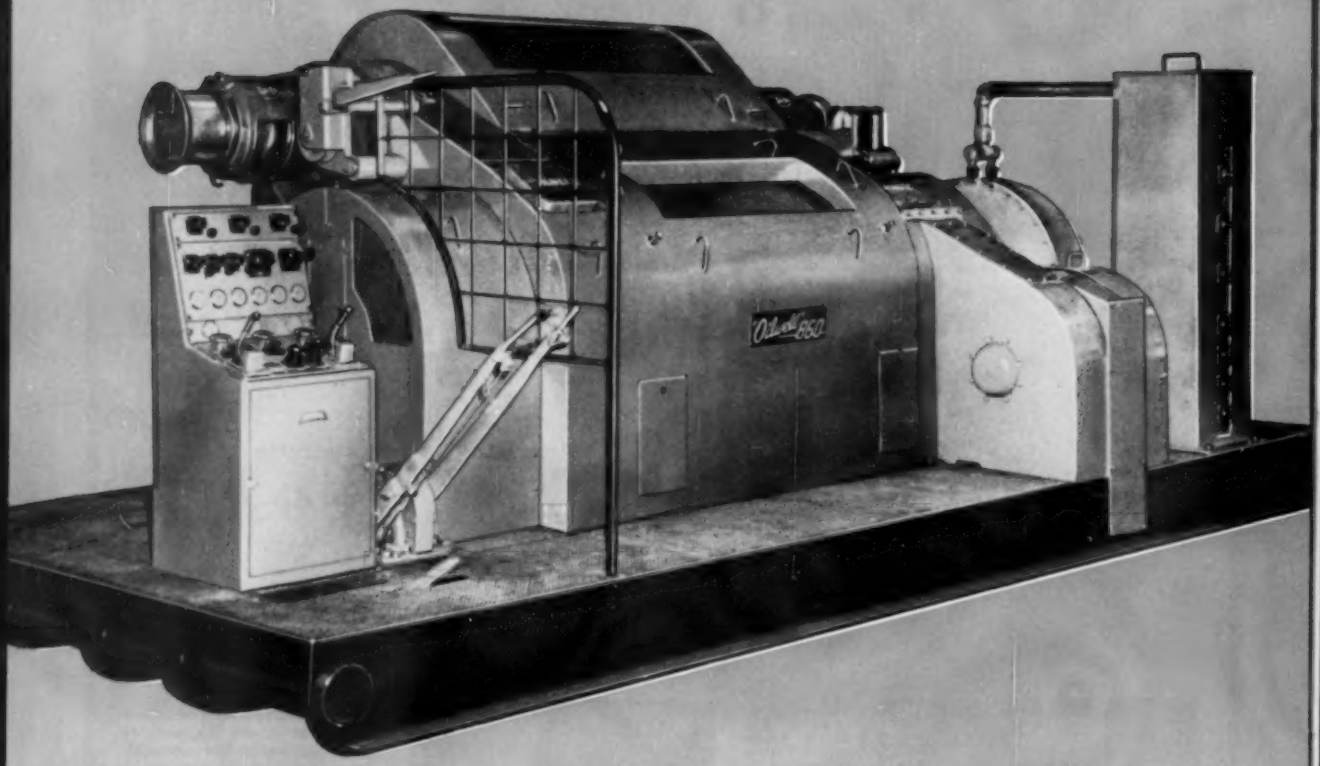

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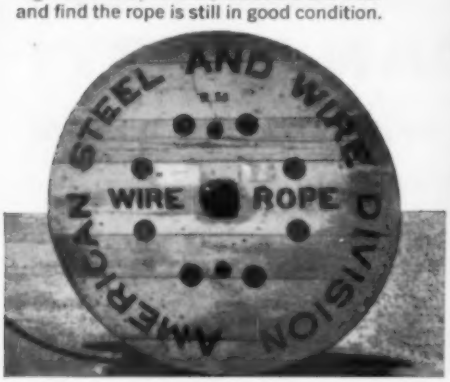

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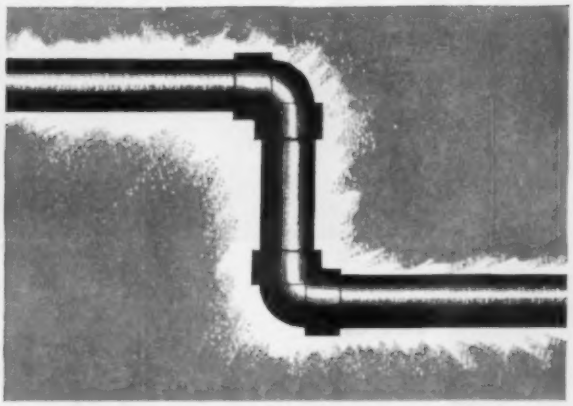
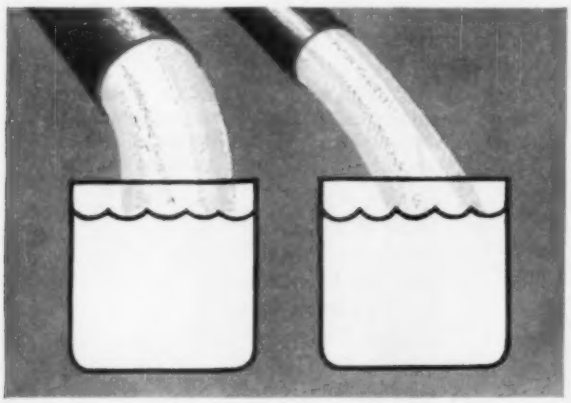


2. corrosion resistant . . . *Geon vinyl is unaffected by chemical corrosion from soil conditions. Likewise it is immune to galvanic action —the major source of high-cost pipeline trouble.*



3. greater fluid delivery . . . *A Geon pipe 20% smaller in diameter than steel pipe gives the same fluid delivery because of lower frictional loss.*

4. faster installation . . . *Besides being light, Geon pipe is easy to handle, cut and join. Two men can lay a mile of three-inch Geon pipeline in eight hours. A similar lay with metal pipe would take 24 to 30 hours; cement-lined pipe some 80 hours.*

4 ways you save with Geon vinyl pipe

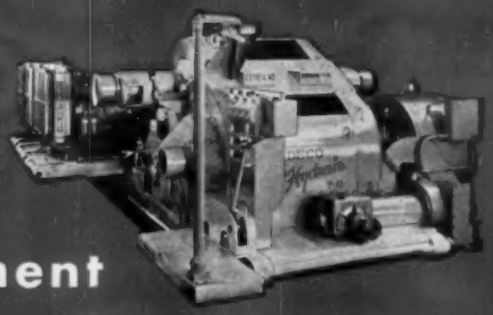
IN performance, too, you save with Geon vinyl pipe. It has high impact and tensile strength, is exceptionally resistant to oil, acids, alkalis and most chemicals. Its smooth internal surface reduces flow resistance, inhibits build-up of deposits.

Get information on rigid Geon polyvinyl compounds 8700A and 8750 for rigid plastic pipe. Write Dept. FN-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

J&L SERVICE
makes IDECO Rigs a blue chip investment



DEPTH RATINGS (FEET) WITH 4½" DRILL PIPE

10,000
16,000
15,000
14,000
12,000
10,500
8,000
7,000
6,000
5,000
4,500
3,300
2,500

RIGS for every job

Get your J&L store on the telephone for information about new IDECO rigs — 2500 Series in electric, torque converter, mechanical, with 2500 HP input.

1350-S AIR-FLO; 1600-2400 HP input; torque converter drive.

PR-1350 AIR-FLO POWER RIG; 1500 HP input; mechanical or fluid coupling drive.

PR-1050 POWER RIG; 1400 HP input; mechanical or fluid coupling drive.

SUPER 7-11; 1250 HP input; torque converter, fluid coupling, or mechanical drive.

H-7-11 HYDRAIR; 700-1050 HP input; torque converter drive.

M-750 mechanical drive; H-750 torque converter drive; 750 HP input.

H-525 HYDRAIR; 600 HP input; torque converter drive.

H-40 HYDRAIR; 400 HP input; torque converter drive; skid mounted, or trailer mounted as a Rambler rig.

H-35 HYDRAIR; 350 HP input; torque converter drive; skid mounted, or trailer mounted as a Rambler rig.

H-30 HYDRAIR; 300 HP input; torque converter drive; skid, truck, or trailer mounted. Servicing depths to 10,000'.

H-25 HYDRAIR; 230 HP input; torque converter drive; skid, truck, or trailer mounted. Servicing depths to 9,000'.

H-20 HYDRAIR; 200 HP input; torque converter drive; skid mounted, or trailer mounted as a Rambler rig. Servicing depths to 7,500.

PARTS for every rig

An IDECO rig is more than a highly functional piece of rugged equipment.

It's a blue chip investment guaranteed practical by J&L parts service, finest in the United States and Canada.

When you move in with an IDECO, parts are ready. Regularly expendable parts are available at all J&L stores in active drilling areas. Major parts are stocked by J&L stores at these points:

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Great Bend, Kansas
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Odessa, Texas
Wichita Falls, Texas
Natchez, Mississippi
Houma, Louisiana
Hobbs, New Mexico
Edmonton, Canada

Jones & Laughlin
SUPPLY DIVISION – Tulsa
SERVING THE UNITED STATES AND CAN

ALL IDECO RIGS have air controls and air clutches — fast, smooth, flexible. The torque converter on Hydrair hoists provides infinitely variable speed with high torque multiplication. Exactly the power you need is always there without throttling, clutching, declutching. Call any J&L Supply number for IDECO Catalog giving detailed descriptions, specifications, performance characteristics of the world's most wanted rigs.

13-M

Why DARLING-McEVOY 2-way conduit gate valves

JUST CAN'T LEAK!

IT'S simple. Regardless of flow direction, a sealant *automatically* completes a pressure-tight seal between the downstream seat and gate. This is the inevitable result of pressure differential at the time of closure.

Similarly there can be no behind-the-seat leakage! For, as shown here, each seat is *double-grooved* to seal against the valve body as well as the gate.

It is this unique feature, with its positive, automatic self-sealing, that establishes the Darling-McEvoy conduit gate valve as the world's tightest!

Isn't it likely that you could benefit by such valve performance as time goes on? Get the *whole* story . . . get details on this and the other unusual features that make these field-proved valves truly outstanding for low-cost, trouble-free operation. Just ask for Bulletin 5402.

Section view of Darling-McEvoy 2-way conduit gate valve, showing twin sealant reservoirs, double-gate parallel seat design, and sealing grooves. Sizes: 8 inch and larger.

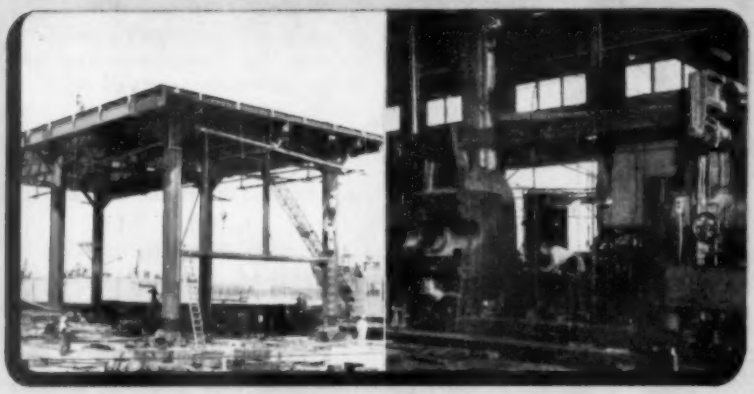
DARLING
DARLING
VALVES

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

For Tidelands Oil . . .

Peak Capacity, Nearby



this is **AVONDALE'S** story

A map illustrates the fact . . . that in the fan-shaped riches of the Tidelands, there is one centrally-located point for construction and repair. That point is Avondale, with four major divisions compactly grouped in the New Orleans area. Moreover, Avondale has the facilities—the capacities—the special production tools required by offshore operations. For a small job —quick repair of a piece of drilling equipment—there is Avondale's enlarged Oil Field Machine Shop. For the design and construction of an elevated deck drilling barge—a big job in every sense of the word—there are Avondale's vast facilities at the River Plant. Yes, when you want the best and you want it fast, your nearest and most complete source is Avondale . . .

ability · integrity · capacity

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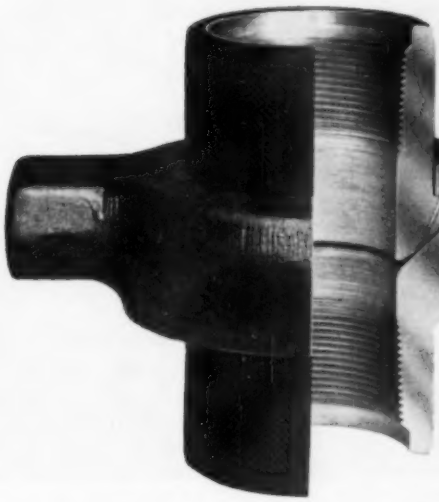
AVONDALE MARINE WAYS, INC.

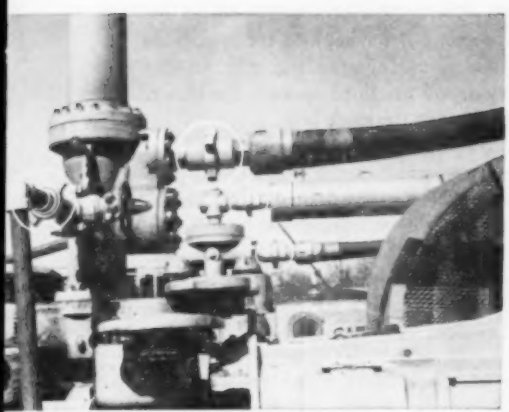
CABLE ADDRESS "AVONWAYS"

P. O. BOX 1030 • PHONE UNiversity 6-4561 • NEW ORLEANS 8, U. S. A.

Perfect sealing is a matter of engineering principle with WECO unions



Ball and Cone Seat Design Provides Positive Leakproof Seal for High or Low Pressures.



For 23 years, WECO Unions have set the standard for the industry; have stayed out in front because of a fundamentally correct engineering principle—the ball and cone design that prevents leaks under high pressures, shock, surge or vibration.

With the spherical male part seated in a concentric circle in a mirror-finished conical female part, unequaled metal-to-metal sealing is obtained time after time, every time.

In addition, WECO Unions have stronger subs and wing nuts, heavier wall construction and sturdy Acme threads. Thus, they stand up on the toughest jobs, continue to operate with easy efficiency under extremes of pressures, volumes and abrasions.

There's a WECO Union for every oil industry service—from the world's most complete line. Available at supply stores everywhere, in sizes from 1" through 12", pressures from 1,000 through 15,000 psi.

U-2-57

WECO®

WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of*
FOOD MACHINERY AND CHEMICAL CORPORATION

PESA

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Bulk Barite for mud make-up...

From truck to storage bin *. . . bulk barite is handled simply, quickly with Denison hydraulic power.*

Photos courtesy Louisiana Baroid Sales, Division of National Lead Company

DENISON hydraulic power speeds its handling

***Denison 2000 psi Hydraulic Motor** drives the blower for delivery of air to the air slide unit in the truck bed.*

***Denison 2000 psi Hydraulic Motors** are used to drive two separate conveyors. One motor powers vertical conveyor . . . second motor drives universal screw feed.*

"Tank Car" delivery of bulk barite. You could call it that because of the ease with which Louisiana Baroid Sales Division now handles its deliveries . . and mighty *fast,* too.

Bulk deliveries of up to 250 sacks in 10 to 15 minutes . . . over 12 tons of material are transferred from truck to drill site storage bins in a single, simple operation . . . with an assist from a Denison 2000 psi hydraulic system. Here's how:

A vane-type hydraulic pump, driven by a power take-off on the truck, furnishes the hydraulic power to the system. In the system are three hydraulic motors—one drives a vertical screw conveyor, another operates the boom screw conveyor, and the third operates the blower for delivery of air to the air slide unit in the truck bed.

The air slide provides barite to the vertical screw conveyor and into the boom screw feed. The boom screw, which can be swung to any position by hydraulic cylinders, delivers barite to any desired point. The result is a compact and foolproof system—easy to regulate and trouble-free.

Simplifying oil field operations is a job that Denison hydraulic power can do best. Your Denison representative is a specialist in such needs. Why not call him in on your next job calling for controlled power. Write Denison Engineering Division, American Brake Shoe Co., 1176 Dublin Road, Columbus 16, Ohio.

Branch Offices:

- 2501 Bartlett Street, Houston 6, Texas
- 208 Wright Building Annex, 3rd & Cheyenne, Tulsa, Oklahoma
- 565 North Prairie Avenue, Hawthorne, California

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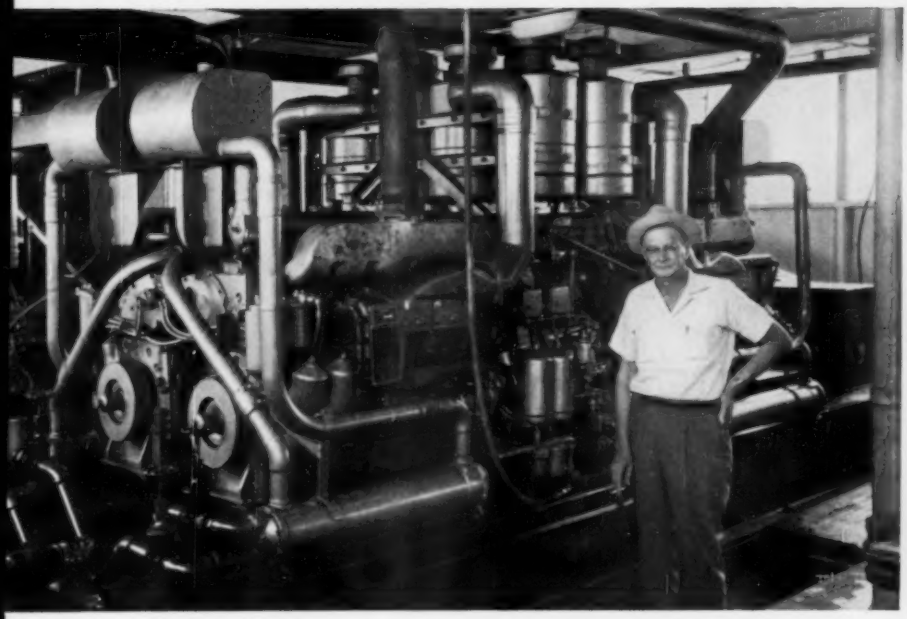
HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

DEPENDABLE POWER



This is the Stewart & Stevenson GM Diesel 6-110 Quad and a man who knows his power — Joe E. Hellman, drilling superintendent for Glasscock Drilling Company

ECONOMY, LONG LIFE AND POWER—FROM 6-110 QUAD

What does a drilling superintendent look for in rig power? Ample power, of course . . . but economy of operation and long life, too. And these are the qualities found by the Glasscock Drilling Company on its Rig No. 14.

Joe E. Hellman, drilling superintendent for the company, says: "Glasscock now operates approximately 220 GM Diesel engines on drilling rigs and for other marine applications. Our company has standardized on GM Diesels because of their obvious economy, long life and good service rendered by Stewart & Stevenson Services, Inc."

On Glasscock Rig No. 14, a Stewart & Stevenson GM Diesel 6-110 Quad provides a 1000 H.P. wallop for the Gardner-Denver GP-GXR-H Mud Pump. There's power to spare.

The new 6-110 Quad develops 880 to 1000 continuous H.P., or up to 1200 intermittent H.P.

It couples POWER AND ECONOMY.

STEWART & STEVENSON

STEWART & STEVENSON SERVICES, Inc.

Main Office and Plant:	4516 Harrisburg Blvd., Houston 11, Texas Phone CApitol 5-5341
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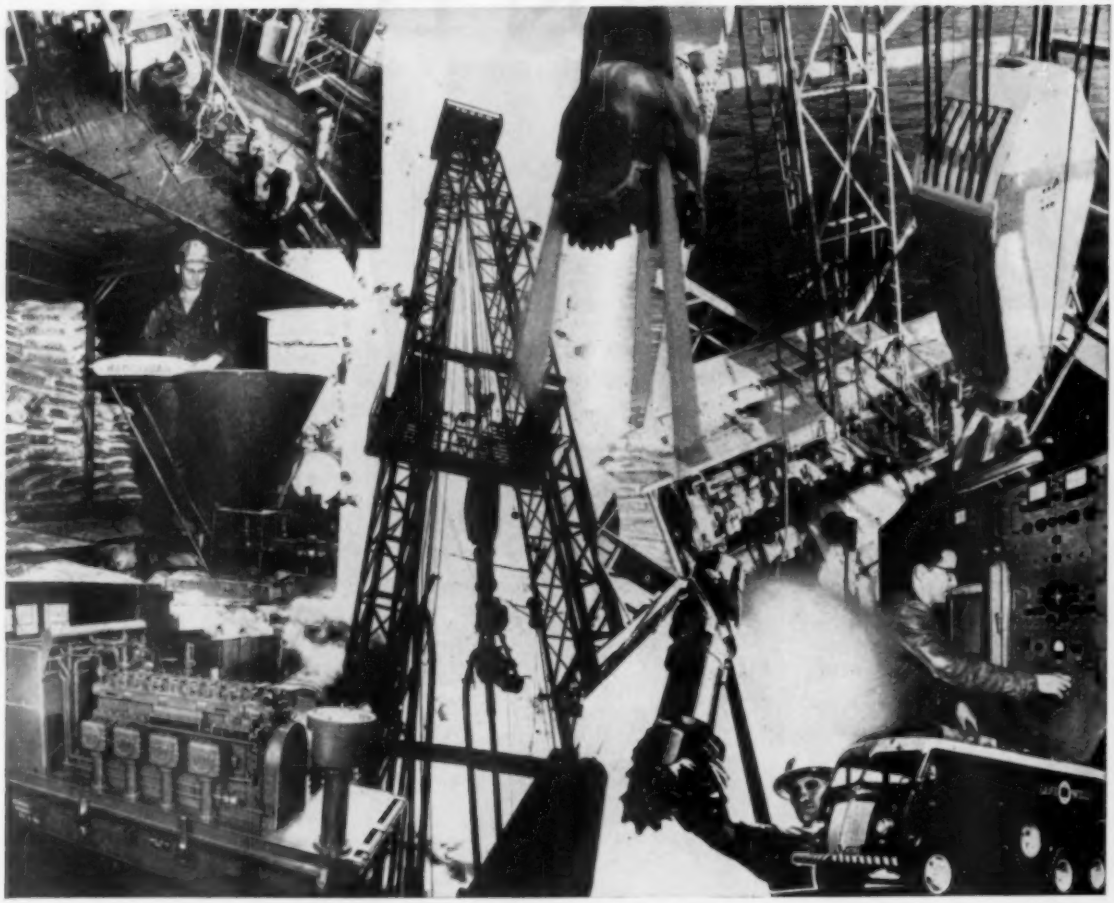
We're proud of our record in meeting every power need for the nation's leading drilling contractors

THE WORLD'S LARGEST DISTRIBUTOR OF DIESEL ENGINES



Tomorrow's Progress Planned Today

AMERICAN ASSOCIATION OF OILWELL DRILLING CONTRACTORS

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DRESSER salutes the members of the American Association of Oilwell Drilling Contractors for their great contribution to the progress of the petroleum industry.

THE DRESSER INDUSTRIAL TEAM SERVES THE GROWING OI

the Dresser Badges of Merit plus+

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CLARK BROS. CO., Olean, New York —Gas turbines, engines, and reciprocating, centrifugal and axial flow compressors—gas, steam, electric and diesel driven.

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DRESSER-IDECO COMPANY, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, electric power substations.

DRESSER MANUFACTURING DIVISION

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

GUIBERSON

THE GUIBERSON CORPORATION, Dallas, Tex.—Swabs, packers, anchors, workover equipment—drilling heads, blowout preventers, tubing blocks, hooks, swivels, kellys, savers, unions. Gas lift equipment. Molded rubber products.

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IDECO, Dallas, Tex.—Hydrair* and Power Rigs; Full-View* Masts; substructures; single, dual and Drive-In Rambler Rigs; blocks, swivels, rotaries; mud pumps; petroleum equipment and supplies.

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LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot* perforating and bullet perforating, packers and bridging plugs.

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MAGNET COVE BARIUM CORP., Houston, Tex.—Magcobar* and Magcogel* drilling muds and other specialized oil well drilling fluids and chemicals.

PACIFIC

PACIFIC PUMPS, INC., Huntington Park, Calif.—Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells

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ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, vacuum pumps, and positive displacement meters.

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SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, reamer rock bits and hole openers; reamers, casing scrapers and Neo-Red rubber stabilizers.

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SOUTHWESTERN INDUSTRIAL ELECTRONICS CO., Houston, Tex.—Seismograph systems and instruments—electronic, electro-mechanical. Computers—analog and digital; recording systems. Special transformers, reactors.

WELL SURVEYS

WELL SURVEYS, INC., Tulsa, Okla. —Nuclear and electronic research and development for the petroleum and other industries. Originators of radioactivity logging.

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put this DRESSER *plus+* team to work for you!

You receive a bonus of extra value whenever you are served by any one of the Dresser companies. *Men with imagination* provide the research, engineering, manufacturing and service applications for the particular specialties of each Dresser operating unit. All Dresser companies work together with their combined experience and facilities to form the world-wide Dresser industrial team. This inter-company teamwork offers a bonus in greater experience and technical knowledge – backed by the extensive Dresser facilities – in the customer's specific industry. This intangible but important factor is known the world over as the Dresser plus+ . . . the mark of superior equipment and services for the oil, gas, chemical, electronic, and general industry.

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FAILING rigs operated by Robert H. Ray, Ltd. in Pakistan, with temperatures 130° in the shade!

ROBERT H. RAY, LTD.
goes places
WITH FAILING RIGS

Gordon Causey,
Pakistan
Seismic Supervisor

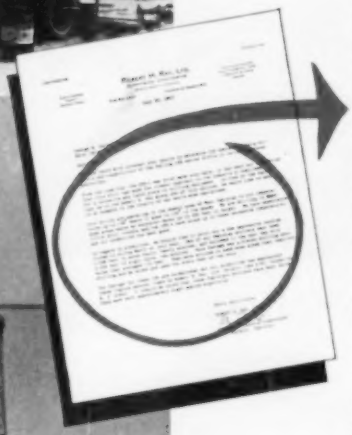
drilling in sun temperatures up to 150° in Pakistan

PAKISTAN is but one of 16 foreign countries in which the Robert H. Ray Company is drilling this year — in addition to crews operating in the United States, Alaska, Canada, and North Africa.

Since January, 1939, this progressive company has provided the petroleum industry with dependable, world-wide Geophysical Prospecting Service. With headquarters in Houston, Texas, the Robert H. Ray Company operates from 14 foreign offices in addition to those in the United States and Canada, employing more than 570 persons plus many national laborers. This letter gives additional details:

R.H.R. Unit 933 uses Failing 1500 drill for 12 month record of 100,000 feet of water-wells and shot holes.

R.H.R. Unit 934 uses Failing 1500 drill for 12 month record of 100,000 feet of water-wells and shot holes.



George E. Failing Company
Enid, Oklahoma
Gentlemen:

From the time that the CFD-1 was first made available, it has been our contention that this drill has made the closest approach to the industry's requirements for a versatile and rapid piece of drilling equipment. In view of the fact that we of the Robert H. Ray group are of this opinion, we would like to point to an example in one country of our world-wide operations.

Your drills are operating in the desert area of West Pakistan in sun temperatures up to 178° where it goes to 130° in the shade. We are drilling in sand dune areas where we encounter dunes up to 300 feet in height. We have experienced little drill trouble and the CFD's have stood up to these excessive temperatures and our production has been good.

In regard to production, we should like to point out a few impressive records turned in during March of this year. One of our Pakistan drillers went down 2,028 feet in seven hours, twenty minutes, and followed it the next day with 2,256 feet in eight hours, ten minutes. This footage was achieved drilling shot holes that averaged 170 feet. They were drilled in sand dune areas that required drilling mud be mixed and used for every foot of the hole.

The footage for these two are exceptional but our production has approached these figures several times on Robert H. Ray, Ltd. seismic crew S-93, headed by E. J. Glenn. It should be noted that these Pakistani drillers have been doing this work with approximately eight months experience.

Yours very truly,
ROBERT H. RAY, LTD
Gordon D. Causey, Supervisor
Karachi, Pakistan

Egyptian drilling crew on Failing 1500 in Egypt.

GEORGE E. *Failing*® COMPANY

A subsidiary of Westinghouse Air Brake Company

ENID, OKLAHOMA, U.S.A.

GEORGE E. FAILING COMPANY

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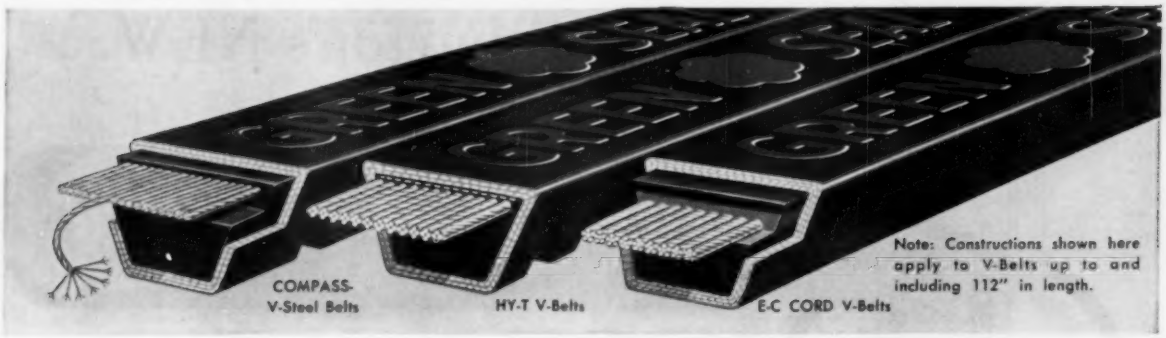
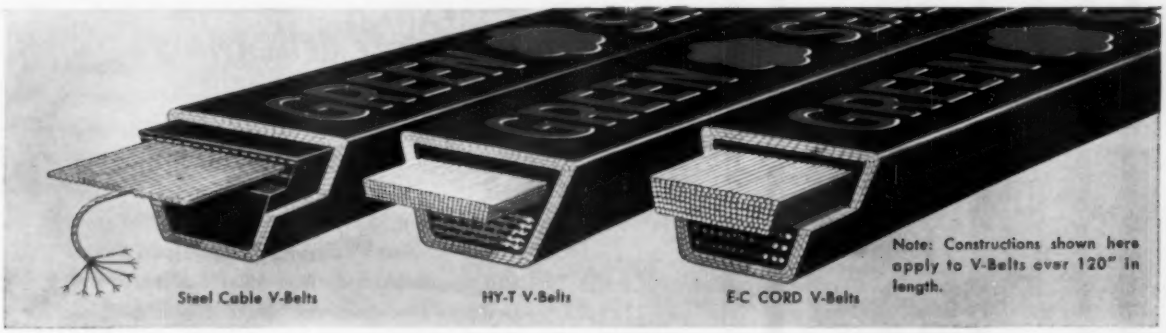
What's different about


COMPASS-
V-Steel Belts
HY-T V-Belts
E-C CORD V-Belts
Note: Constructions shown here apply to V-Belts up to and including 112" in length.

V-Belts with the Green Seal?



Plenty—when you're belting multiple drives. For that Green Seal certifies the dimensional stability of every belt that carries it. There's no surer guarantee that every belt in a set will match every other one—perfectly. And that they'll *stay* matched no matter how long you stock them before installation.

So the dimensional stability of Green Seal belts is solid protection against "loafing," slipping, stretching, scorching and other mismatching troubles. And most of the credit belongs to the belts' load carriers of airplane-type steel cables or Triple-Tempered (3-T) cord — Goodyear "exclusive" cord that's carefully tempered with Tension, Temperature and Time.

This unique 3-T process brings the synthetic cord to its point of greatest strength and stability. Result: the end of shrinkage in storage—plus greatest shock- and stretch-resistance in use. All of which assures you maximum, trouble-free horsepower hours at minimum cost. Why settle for less?

DIMENSIONALLY STABLE V-BELTS with the GREEN SEAL by

GOODYEAR

THE GREATEST NAME IN RUBBER

The Goodyear Tire & Rubber Company, Dept. 794, Akron 16, Ohio

Please send me complete information on what makes V-Belts with the Green Seal different from any others made today.

Name_____

Company_____

Street Address_____

City_____ **Zone**_____ **State**_____

Compass, E-C Cord, Hy-T, Green Seal—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

ANNOUNCING Halliburton's NEW

RETRIEVABLE VALVE TESTER

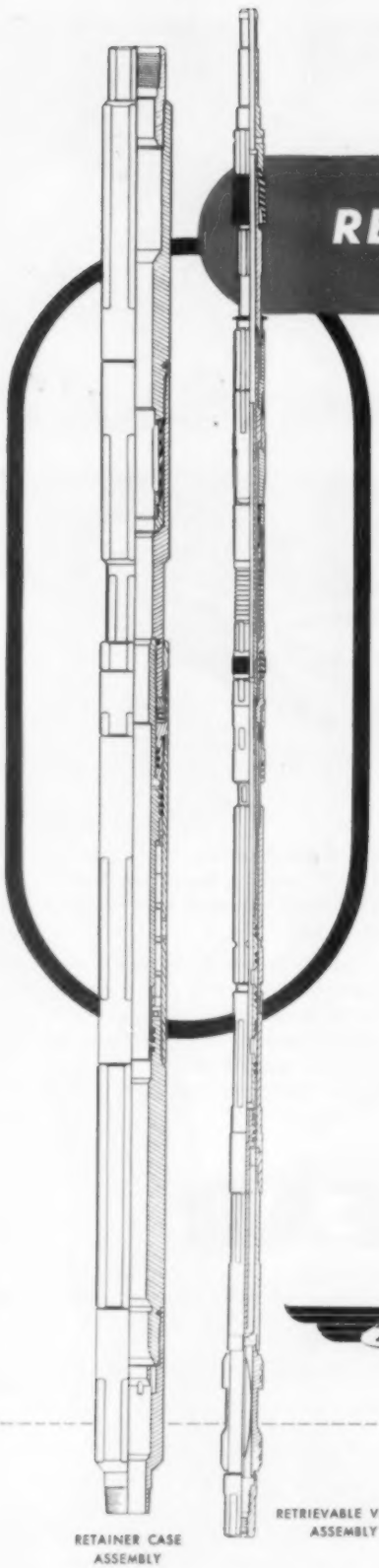
a NEW method for better

- *FORMATION TESTING*
- *TREATING*
- *SQUEEZE CEMENTING*

Reduced rig time in well evaluation and completion operations is made possible by a new Halliburton service tool, the Retrievable Valve Tester. Several operations such as drill stem testing, cement squeezing, treating, perforating and simultaneous gamma-collar logging can be performed without the usual time-consuming round trips with the tubing between operations.

Halliburton's new testing tool, consisting of two assemblies—the retainer case and the retrievable valve—is used with a retrievable test, treat and squeeze packer. The case is run in the tubing string with the packer. The retrievable valve, with a pressure recording device for obtaining pressure data, can be returned to the surface by wire line or by reverse circulation, leaving the tubing string full open for other operations. Similarly, the retrievable valve and recorder can be replaced in the case by using wire line or pumping methods when another drill stem test is desired... It is not necessary to remove the tubing from the well.

Specify the new Retrievable Valve Tester—Halliburton's newest contribution to better formation testing!



RETAINER CASE ASSEMBLY

RETRIEVABLE VALVE ASSEMBLY

HALLIBURTON

OIL WELL CEMENTING COMPANY, DUNCAN, OKLAHOMA

include the NEW

RETRIEVABLE VALVE TESTER

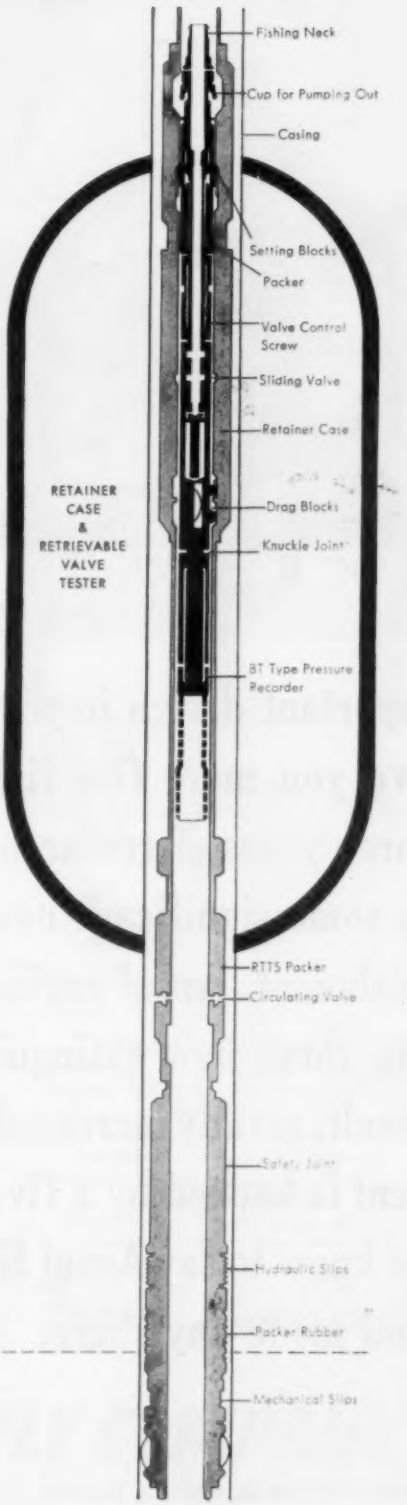
in your Halliburton testing string:

The retainer case, run in the well above the RTTS Packer and remaining a part of the tubing string during all operations, consists primarily of two rotating parts. Locked together by spring loaded lugs that disengage only when sufficient weight is applied, these parts help assure operation of the packer below.

The retrievable valve consists of drag blocks to provide proper positioning within the retainer case, a packing element to seal the valve to the bore of the case, setting blocks for locking the valve in the case, and a screw type mechanism to operate a sliding type valve. The sliding valve uses "O" rings to effect various open and closed positions.

When the retrievable valve is set in place in the retainer case, the upper part of the valve is locked to the upper part of the case, with the lower part of the valve locked, similarly, to the lower part of the case. Any relative rotation between the two parts of the retainer case is therefore transmitted to the retrievable valve. Rotation of the tubing then causes the screw mechanism to operate and pull the sliding valve over the ports.

To test before any other operation, the retrievable valve can be set in the retainer case in the closed position and run in with the tubing dry. After the packer is set and weight is applied, rotation of the tubing will open the retrievable valve for testing, close it for closed-in-pressure and open it for reversing, if desired. Continued rotation of the tubing will cause the screw to continue its upward movement which will release the setting blocks allowing the retrievable valve, with pressure recording gauge attached, to be retrieved ...either by wire line and overshot or by pumping it up the tubing. After the retrievable valve and pressure gauge have been retrieved, the tubing string will be full open for other operations.

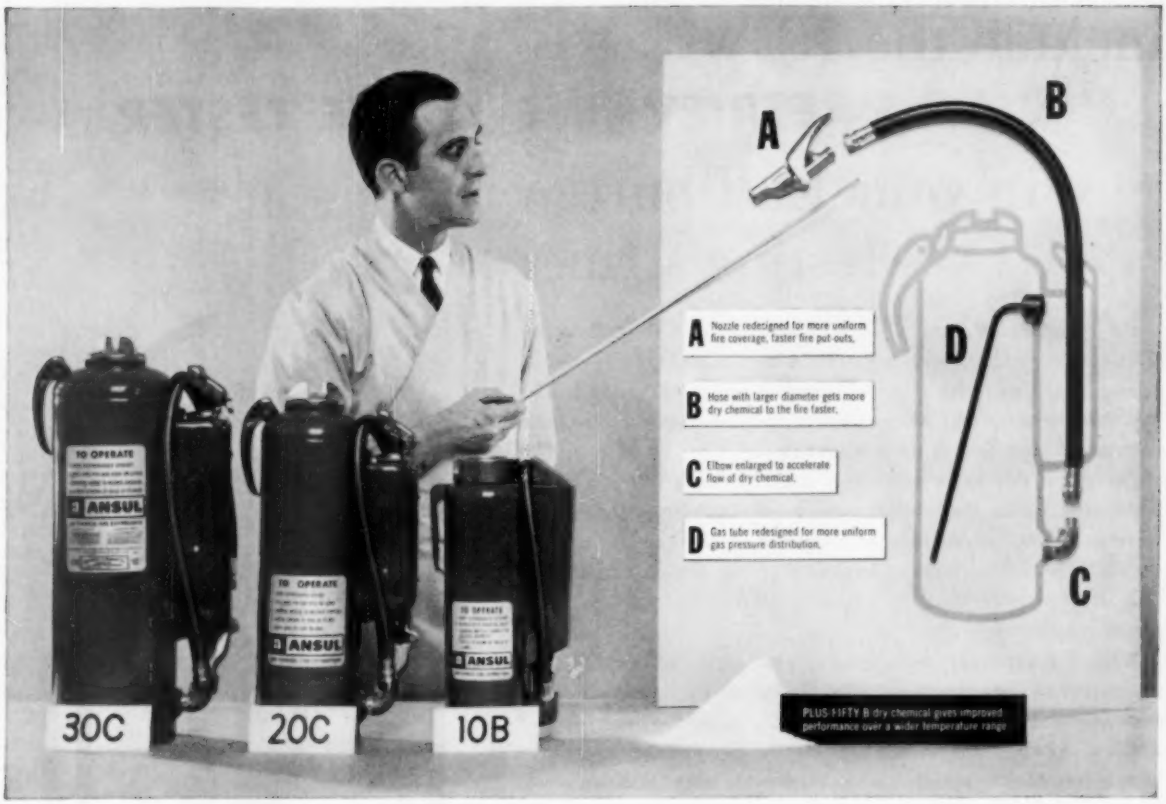


OTHER HALLIBURTON CONTRIBUTIONS TO BETTER FORMATION TESTING

Although the newest development, the Retrievable Valve Tester is only one of many Halliburton contributions to better drill stem testing. To be fully informed about all the Halliburton testing tools and techniques, to realize the benefits of more accurate well evaluation data, call your Halliburton tester today!

TESTING SERVICE

251 SERVICE CENTERS
JUST MINUTES AWAY FROM YOUR WELLS

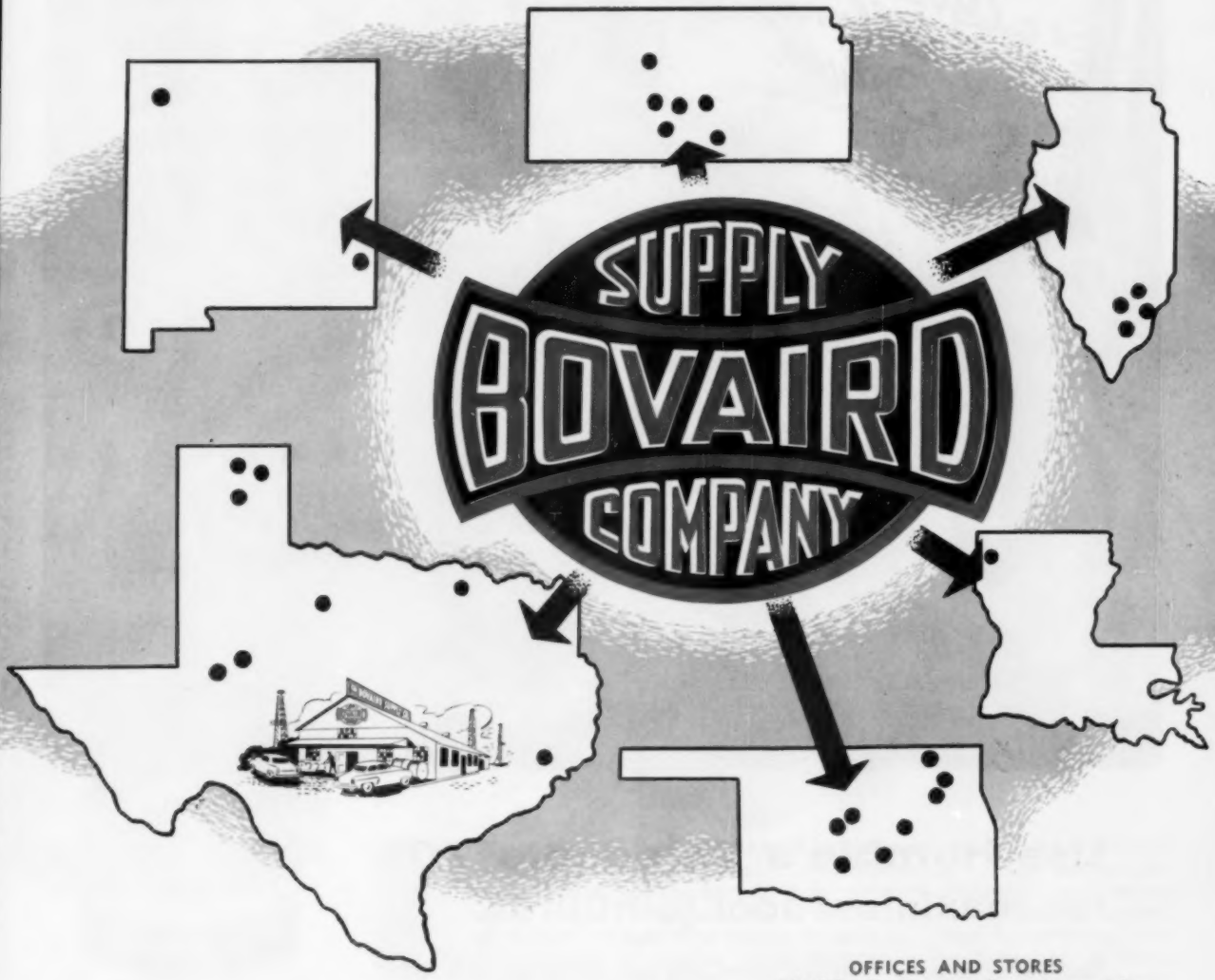

A
B
D
C
A Nozzle redesigned for more uniform fire coverage, faster fire put-outs.
B Hose with larger diameter gets more dry chemical to the fire faster.
C Elbow enlarged to accelerate flow of dry chemical.
D Gas tube redesigned for more uniform gas pressure distribution.
PLUS-FIFTY B dry chemical gives improved performance over a wider temperature range
30C
20C
10B

Important design improvements in these Ansul Extinguishers give you more fire fighting power at no increase in price. Three years of research and more than 2000 fire tests turned up some significant new information on dry chemical extinguishment. Ansul engineers were able to design these findings into three new extinguisher models, the 10B, 20C and 30C. Result, greatly increased fire fighting power. All Ansul equipment is backed by a five-year warranty. This is the best way we know to say Ansul fire extinguishers are the finest of their kind made anywhere.

ANSUL

The Ansul Chemical Co., Marinette, Wisconsin

Your Supply Center IN THE HEART OF THE OIL COUNTRY



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TO GET WHAT YOU WANT WHERE YOU WANT IT WHEN YOU NEED IT . . . AT REASONABLE COMPETITIVE PRICES

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"Buy From Bovaird"

THE Bovaird SUPPLY COMPANY

GENERAL OFFICES
TULSA, OKLAHOMA

86 YEARS OF PROGRESS WITH THE OIL INDUSTRY

Use **Humble's Thredkote 701** for maximum tool joint life

Thredkote 701 is a top-quality thread lubricant containing 60% pure metallic zinc. When the tool joint is madeup tight, this zinc is deposited on the threads in a thin film. As the string is run, this zinc film effectively guards against metal-to-metal contact and prevents galling.

Thredkote 701 gives the tool joint threads superior lubrication, so the joints will makeup easy and tight. It seals against high pressures, yet permits ready break-out.

Be sure to give new tool joint threads a careful and complete coat of Thredkote 701 for the first four or five trips that they make. New tool joints need this extra lubrication and protection because they resist makeup more than old ones, and their threads are more likely to gall.

Thredkote 701 is one of a complete line of Humble thread compounds. There's one for almost every type of threaded connection. For more information on Thredkote, call your nearest Humble wholesale plant, or write or phone:

HUMBLE OIL & REFINING COMPANY

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It costs so little more to "go first class"

. . . and
UNIBOLT
flow manifolds
give you so much more
for your money

Pressure-tested as a unit and available in a full range of pressures:

3000 lbs. w.p.
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and in "SA" stainless steel for corrosive conditions.

● No exposed threads, concealed seat in groove . . . no accidental damage. ● All metal seals . . . not affected by high or low temperature. ● Lubricators, bottom hole pressure adapters, and valves easily attached to Unibolt Tee. ● Tee cannot be accidentally opened. ● Unibolt stronger than tubing threads . . . ideal for working trees with welded lift nipple. Tubing threads in Tee if desired. ● Wing Valve requires no grease to effect seal. ● Variable opening speeds up initial clean-up or running initial flow tests . . . saves rig time. ● Unrestricted 1" opening in Wing Valve will pass 10,000 bbls. fluid per day with 100 lbs. pressure drop. ● Valve stem packing needs no tightening . . . stem turns freely under high pressures. ● Threads on stem not exposed to internal or external damage . . . full 2½" pilot for true stem alignment and rigidity. ● Stem seat sealed by power threads and metal gasket assures alignment. ● Nitride hardened stem and stem seat . . . resists corrosion. ● Choice of hard chrome plated or "SA" stainless stems and seats. ● Positive Choke Body takes regular or "X" Beans . . . all beans flow-rated. ● Shaped entrance on beans prevents paraffin clogging. ● Positive Choke Body may be replaced with inexpensive tee and cage nipple, or can be converted to Adjustable Wing Valve by substituting two parts. ● Streamlined flow . . . no obstructions . . . no turbulence.

THORNHILL CRAVER CO.
P. O. BOX 1184 HOUSTON, TEXAS

BJ ...the world's leading manufacturer of dies and inserts, makes the finest hand slips too!

The longest, surest gripping surface of any hand slip.

No wonder Byron Jackson makes the finest hand slips. BJ makes the dies and inserts that provide the "teeth" in 95% of the slip elevators, spiders and power slips in use throughout the world. BJ is also the world's leading manufacturer of tong dies.

BJ inserts are used in extremely heavy-duty equipment. (BJ's new combination Elevator-Spider, for instance, can safely hold *500 tons* of casing!) BJ Hand Slips, with their exclusive extra-long gripping surface, have the same kind of rugged holding power.

With 17½" BJ Hand Slips you have the longest, safest, surest possible grip on your drill string – without employing power equipment. BJ slips spread the load over a greater area. They won't damage your pipe.

BJ Hand Slips are well balanced and easy to handle – they keep crew fatigue at a minimum.

Models are available with 14" and 17½" insert lengths and body sizes from 3½" to 7". See your oilfield supply dealer or your Byron Jackson field service man. Remember, your men and your equipment deserve the finest.

Byron Jackson Tools, Inc.

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P.O. Box 2017A, Terminal Annex, Los Angeles 54, California • Cable: "BJTOOL"
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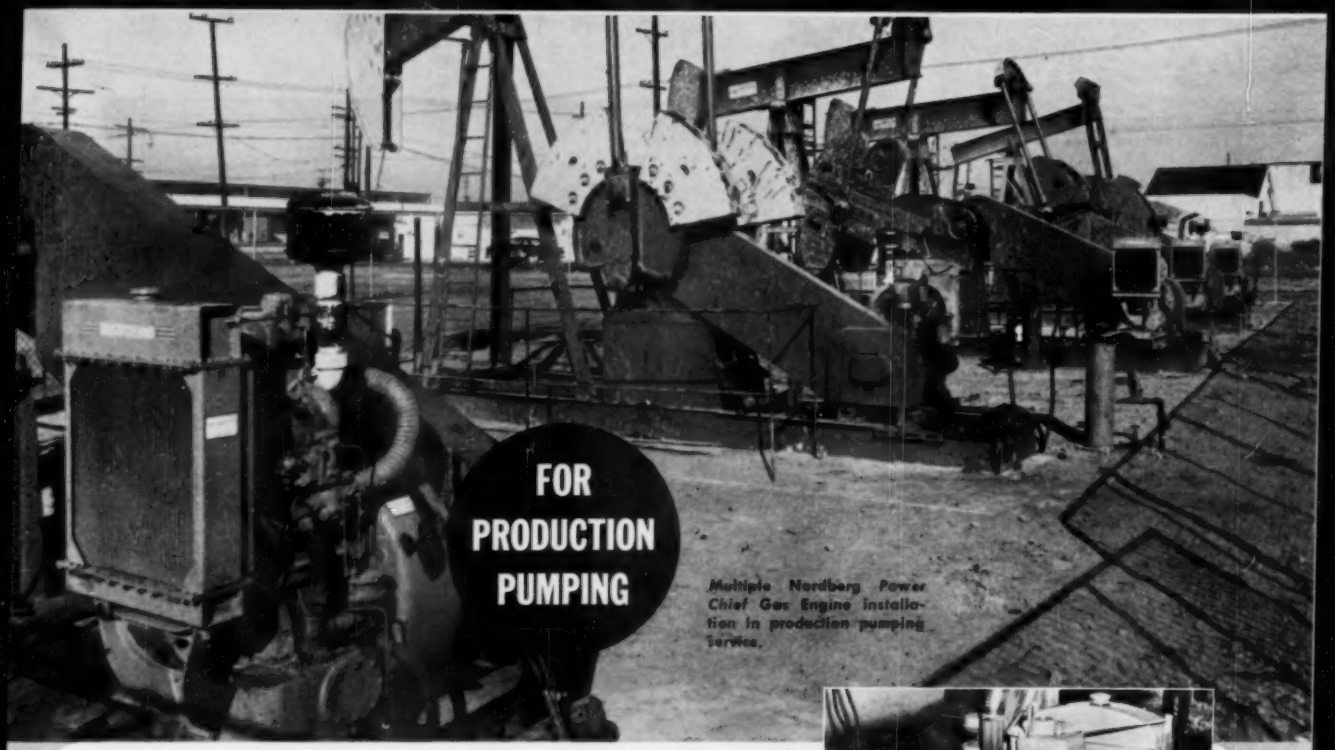
WATCH BJ FOR THE NEWEST



Multiple Nordberg Power Chief Gas Engine installation in production pumping service.

NORDBERG POWER CHIEF® ENGINES

are your BEST BUY!

In the low cost medium speed field, *Power Chief* engines give you all the design, construction and fine quality that has made Nordberg engines famous throughout the world for over 50 years. *Power Chief* engines are so simple in design that they can be maintained, in the field, with only a few ordinary hand tools.

Here are some of the features that make *Power Chief* engines your *Best Buy:*

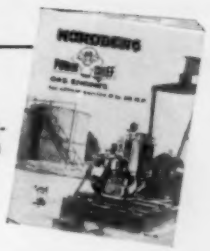
Removable wet cylinder liners • Valves in head • Replaceable valve guides • Special alloy inserted exhaust seats • Positive full pressure lubrication • Internal ventilation bars entry of dirt • Crankcase and all other vital parts fully sealed • Oil heat exchangers maintain proper internal temperatures at all loads • Safety approved, enclosed heavy flywheel smooths out fluctuating loads • Fram oil filters • Vortox oil bath air cleaners • Wico & Bosch magnetos • Twin Disc clutches • Murphy safety shut-down devices. (No extra added costs for these when you buy.)

Power Chief Gas Engines in 1 and 2-cylinder models deliver up to 36 hp maximum rating. *Power Chief* Diesel Generator Sets produce 6 to 30 kw for continuous service. All are available with special vibration-proof mounting. NORDBERG MFG. CO., Milwaukee, Wisconsin

Typical rig-mounted Power Chief Diesel Generator Set for lighting service.

SEND FOR BULLETIN

Write for Bulletin describing Nordberg Power Chief Oil Field Engines.



AVAILABLE AT YOUR LOCAL SUPPLY STORE — OR CONTACT THESE AUTHORIZED DISTRIBUTORS:

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NORDBERG

POWER CHIEF

DIESEL and GAS ENGINES

4-657-O

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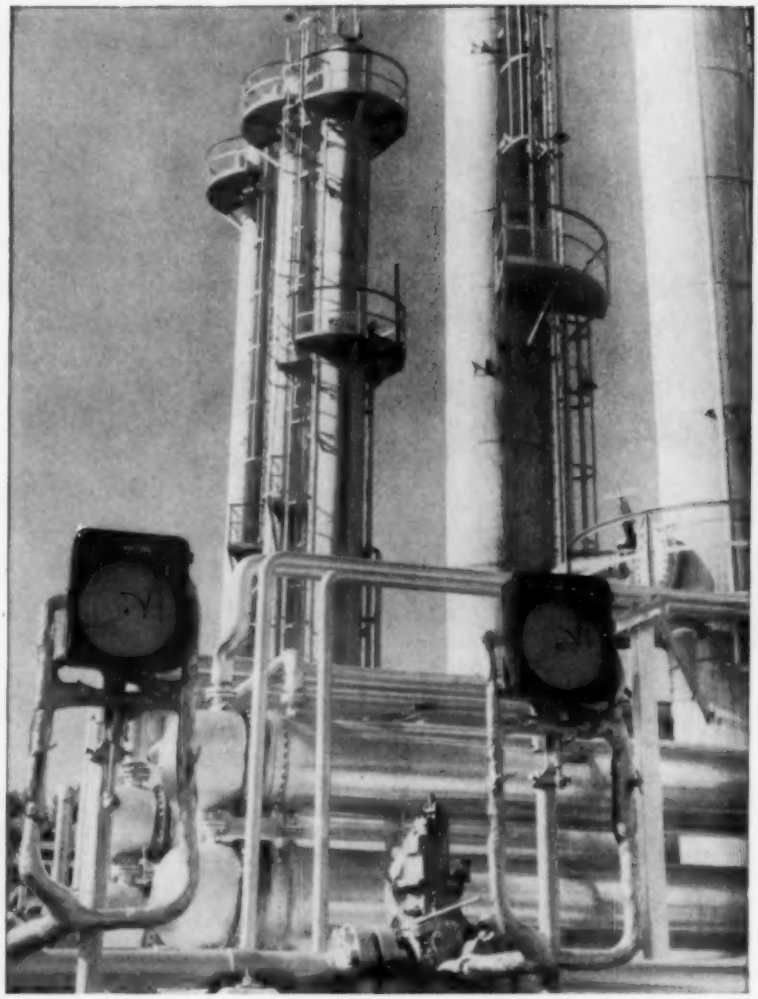
Rockwell Orifice Meters and Chart Drives



Weather Proofed AGAINST

HEAT • COLD • ABRASION • CORROSION

CORROSION RESISTANT MATERIALS, inside and out, make Rockwell gauges and chart drives perform best "off-shore," on sour gas and in corrosive atmospheres.

SEALED INSTRUMENT CASES guard these precise mechanisms against contaminating outside influences such as moisture, sand and wind.

UNIQUE LUBRICATION of bearing surfaces and pivot points assures uniformly free performance in tropic heat and arctic cold.

BETTER ENGINEERING AND DESIGN is your cue to the better performance you can expect from these Rockwell products on any service, under any conditions.

Write for bulletins

ROCKWELL MANUFACTURING COMPANY

INSTRUMENT DIVISION BOX 2396, TULSA, OKLA.

Atlanta Boston Charlotte Chicago Dallas Denver Houston Los Angeles Midland, Texas New Orleans New York N. Kansas City Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa In Canada: Rockwell Manufacturing Company of Canada, Ltd., Toronto, Ontario

New SERVCO LINER MILL

mills 29′ of 4¾″ pre-packed gravel liner wrapped with wire mesh

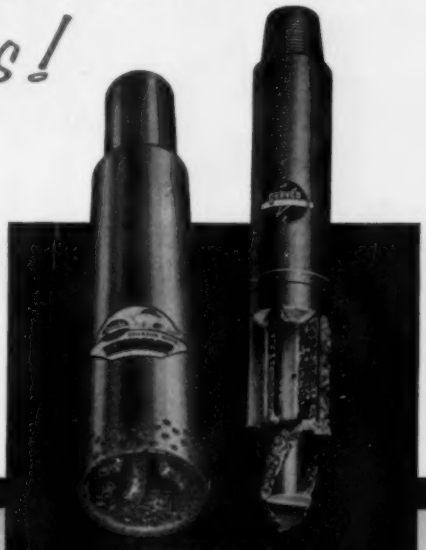
in 7 hours, 15 minutes!

Phenomenal cutting speeds possible through use of revolutionary new Servcoloy* dressing material.

The phenomenally-fast milling speeds possible with the new Servco Liner Mill is largely due to the cutting principle of Servco's exclusive Servcoloy process. Hundreds of carbide particles are suspended in a tough, elastic matrix. As particles are worn or torn away new cutting edges are automatically put to work. Hundreds of fresh cutting edges are always against the surface to be milled.

In areas where liners must be pulled frequently, this new tool is fast replacing the old method of cutting and jarring or using a hydraulic pull tool. It is especially useful when liners are corroded, which causes slips of spears, inside cutters or hydraulic pull tools to function improperly.

*Patents pending.



TWO TYPES AVAILABLE:

Standard — Completely mills up all types of liners both inside the casing and below the casing shoe.

Shielded Liner Hanger Mill — For milling hangers inside casing.

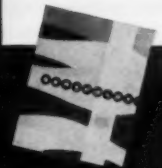
ACTUAL JOB RECORDS *PROVE* SERVCOLOY'S SUPERIORITY

- One tool milled 29′ of 4¾″ pre-packed gravel liner with wire mesh wrap in 7 hours, 15 minutes!
- One tool milled 44′ of 5½″, 20 lb., N-80 blank and perforated casing in 22 hours!
- One tool milled 17′ of 7″, 29 lb., J-55 liner in 4 hours!
- One tool milled 39′ of 5½″, 18 lb., N-80 in 28 hours, 30 minutes!
- One tool milled 20′ of 4¾″, 18 lb., J-55 in 14 hours!

Servcoloy now available on all Servco milling tools

Taper Mills
Junk Mills
Rotary Shoes
Section Mills
Tubing Mills
Whipstock Mills

TAPER MILLS | JUNK MILLS | ROTARY SHOES



Complete information on the Servcoloy process and Servco milling tools is contained in a new 8-page brochure. Write for your copy today.

Send inquires to

SERVCO

4920 Holmes Road, Zone 21 • Houston, Texas

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The answer may be in the bag

(Dow tech service serves as a short cut in dehydration problems)

"Time is money," the saying goes. And where time is to be saved in solving gas dehydration problems, you're likely to find a Dow tech service man armed with facts.

His experience on the use of glycols—and ethanolamines—often shows the short route to the answer. Yet his is a divided responsibility that works for your good. When our technicians are not in the field giving on-the-spot help, they're back in our lab analyzing samples with up-to-date equipment.

Unaccountable losses may be causing you to ask yourself, "Is my process as efficient as possible? Am I getting the most for my glycol dollar?"

Certainly, you have the know-how to find the answers yourself. But with Dow tech service on your side, trial and error are minimized. You often find the solution as near as one of our representative's carrying case. THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept.GD813K-2

YOU CAN DEPEND ON DOW

THE HEAVIER THE LOAD...

the more you need HYATTS . . . because size for size, no other kind of bearing made can equal straight cylindrical roller bearings for sheer load-carrying capacity in heavy-duty service. That's why John Deere uses HYATTS in this combine.

THE HIGHER THE SPEED...

the more you need HYATTS . . . because their uncompromising combination of superior steels, precision manufacture and scrupulous control of internal clearances assures smoother performance in high-speed applications like the famed *Firebird II.*

THE MORE YOU NEED *Cylindrical* HY-ROLL BEARINGS

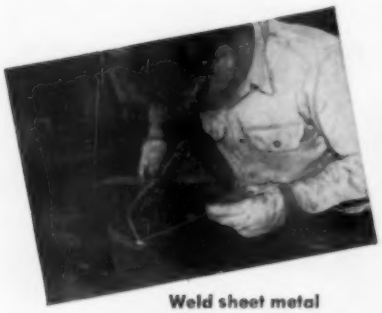
Today, with loads and speeds trending upward and space often at a premium, many a manufacturer is finding that bearings of limited capacity are no longer good enough. If you are seeking ways to squeeze better life/load ratings into smaller housings, HYATT has the answer. Shouldered-race HYATT HY-ROLLS will not only solve your radial load problem but take a surprising amount of thrust, too. Ask your nearest HYATT Sales Engineer for recommendations—he's a mighty good man to know! Hyatt Bearings Division, General Motors Corporation, Harrison, N.J.; Pittsburgh; Detroit; Chicago; and Oakland, California.

THE RECOGNIZED LEADER IN CYLINDRICAL BEARINGS

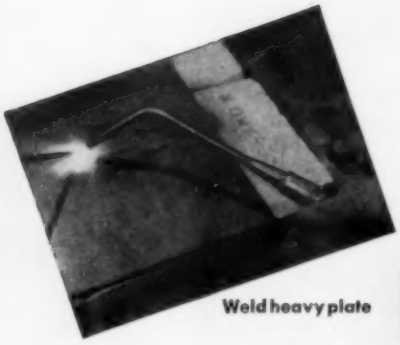
GM GENERAL MOTORS

HYATT HY-ROLL BEARINGS

THE "WORKHORSES" OF MODERN INDUSTRY



Weld sheet metal



Weld heavy plate

Handle heavy heating

NOW . . . . one blowpipe handles all your welding, cutting and heating needs

New OXWELD W-47

Cut metal

Here's another LINDE "first" . . . the all new OXWELD W-47 Welding Blowpipe. Backed by more than half a century of experience and engineering skill, the new W-47 Blowpipe offers you a host of efficiency-increasing features never before available in a single welding blowpipe.

Widest Work Range—Weld sheet metal as thin as 28 gage or the heaviest plate. Convenient cutting attachment quickly converts the W-47 to flame-cutting work on metal up to 8 in. thick.

Largest Flow Capacity—Handle any oxygen or acetylene flow from 2 to 300 cu. ft. per hour. With fuel gas heating heads you can handle total gas flows up to 1500 cu. ft. per hour!

Improved Mixer—New cartridge-type mixer in each head provides thorough, proportionate mixing of gases and prevents flashback—*at all working pressures.*

Trouble-Free Construction—New features include "O" ring gas seals, self-seating valves, and spring-lock welding heads. Stainless steel mixing tubes keep the blowpipe handle cool even during 'round the clock operation!

Full Selection of Accessories—The W-47 offers the largest selection of accessories ever available for use with one blowpipe. In addition to standard welding heads and cutting attachment, a full selection of accessory equipment for flame-priming and descaling is available.

TRY THE NEW W-47 IN YOUR SHOP

Take advantage of all the new features of the OXWELD W-47 in your own shop. Call your nearby LINDE office to arrange for a demonstration or write for free booklet F-1107. Do it today!

LINDE COMPANY DIVISION OF **UNION CARBIDE** CORPORATION

30 East 42nd Street, New York 17, N. Y.

In Canada: LINDE COMPANY, Division of Union Carbide Canada Limited, Toronto

"Linde," "Oxweld" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Confidence...

is essential in R/A logging, too

Confidence is the key in your choice of a surgeon, guided by his experience, his knowledge, his diagnosis and his choice of instruments. Confidence is also the key when you choose Welex R/A Logging based on experience and skill gained from unlimited field work to insure competent interpretation of your radioactivity log and complete assurance of the availability of all the latest equipment. Your confidence in these tools has made Welex a leader in R/A Logging:

3⅛" O.D. Scintillation Counter: the newest and latest logging instrument in use today.

3⅛" O.D. Ionization Chamber: a process with a history of proved effectiveness in R/A Logging.

2⅛" O.D. Geiger Counter: a tool developed for slim hole logging operations.

1¾" O.D. Geiger Counter: to log through-tubing in permanent type completions.

These tools record simultaneously Gamma Ray, Neutron and Casing Collar Logs. The Gamma Ray and Neutron Logs exhibit excellent repeatability and are readily adaptable to quantitative analysis. The Casing Collar Locator picks up collars in flush joint pipe even in the heaviest muds and in extremely high temperature. All Welex R/A Logging instruments, like those of a surgeon, insure you the best possible results.

Our Progress is Measured by Your Confidence

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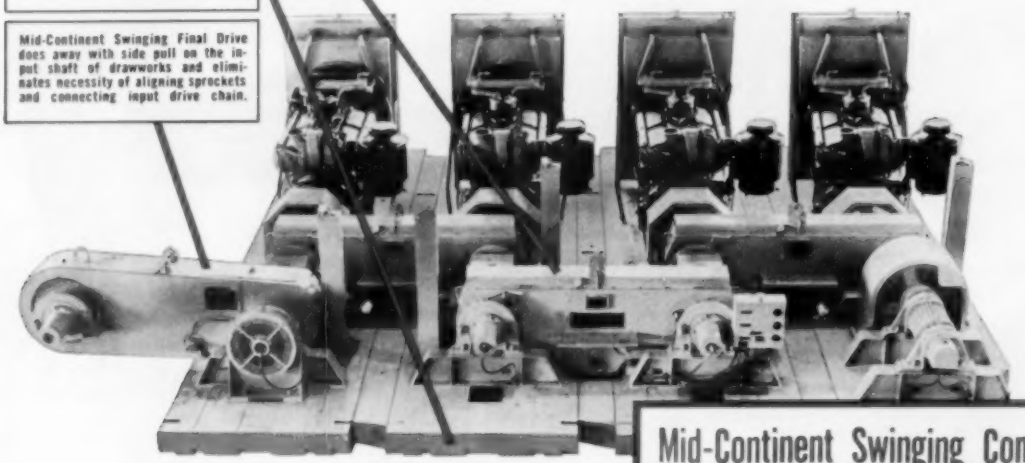
MID-CONTINENT
AE RIG DRIVE

Exclusive Swinging Compounds make moves possible without opening compound cases, draining oil, or "breaking" chains. Dust-proof, oil-tight compound cases are of heavy welded construction. Chains are lubricated from individual oil pumps.

Extra-heavy, four-runner skidded units are within eight-foot highway width limits and have dowel pin connections for perfect alignment.

Mid-Continent Swinging Final Drive does away with side pull on the input shaft of drawworks and eliminates necessity of aligning sprockets and connecting input drive chain.



Compounds Swing
for easy moving... quick rig-up!

Designed for most any engine—drawworks combination, the Mid-Continent AE Rig Drive helps keep non-rotating time to a minimum. Exclusive *Swinging Compounds on all Mid-Continent AE Rig Drives simplify moves and rig-up. Within minutes, compounds can be swung from operating position to vertical locked position for moving, or from vertical to horizontal for drilling. Swinging Final Drive (input to drawworks), specified for many installations, adds still more to the versatility of this practical and dependable Rig Drive. See your Mid-Continent representative today about a Mid-Continent AE Rig Drive for your rig.**

*Patented

Mid-Continent Swinging Compound* Proved in 10 Years World-Wide Service

1947

1951

1955

1957

In 10 years of world-wide service, the Mid-Continent Rig Drive has proved its superiority of design in practical multiple engine drive applications. More than 100 Mid-Continent Rig Drives have been specified by oil companies and drilling contractors for their world-wide drilling operations.

MID-CONTINENT SUPPLY COMPANY

MID-CONTINENT BLDG.
FORT WORTH, TEXAS

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THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

If you're considering deeper or higher pressure wells—

TIMKEN® SEAMLESS STEEL TUBING GIVES YOU INTERNAL PRESSURE STRENGTH TO 15,000 PSI— YIELD STRENGTH TO 125,000 PSI

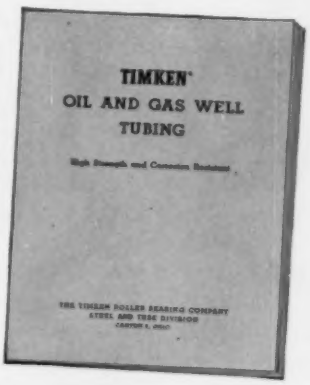
THE WELL HASN'T YET BEEN DRILLED that can apply the pressure Timken® oil and gas well steel tubing can take. To meet the trend to deeper wells and higher pressures, here's tubing that can take internal pressures up to 15,000 psi.

And Timken seamless steel tubing goes beyond the stiffest specifications of the American Petroleum Institute. The highest API specification—5A—calls for a yield strength of 105,000 psi. We offer you up to 125,000 psi yield strength, with maximum uniformity of properties and quality.

Timken seamless steel tubing is available in a variety of sizes and analyses. Some are specially selected for corrosion resistance. All provide high ductility.

Into every foot of Timken seamless steel tubing goes 24 years of experience in pioneering high pressure seamless steel tubing applications for the petroleum and other industries. Several extremely deep oil and gas wells are now using Timken seamless tubing with very satisfactory results.

FREE ENGINEERING STUDY
A recent study by Timken Company metallurgists reviews the properties of various alloys and their application to oil field operation. Get your free copy today of "Timken Oil and Gas Well Tubing". Write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".



TIMKEN *Fine Alloy* STEEL

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

A Bronze yoke bushing nut
B Handy grip iron wheel
C Bronze yoke bushing
D Iron yoke cap with zerk fitting for lubricating bushing
E Steel yoke cap bolts and nuts
F TYPE 316 STAINLESS STEEL spindle
G NI-RESIST CAST IRON, TYPE 2, yoke
H Bronze eye bolt nuts
I Malleable iron gland flange
J Steel gland eye bolts
K Steel gland lug bolts and nuts
L TYPE 316 STAINLESS STEEL gland
M Teflon impregnated asbestos packing
N TYPE 316 STAINLESS STEEL bonnet bushing
O NI-RESIST CAST IRON, TYPE 2, bonnet
P Steel bonnet bolts and nuts
Q TYPE 316 STAINLESS STEEL spindle ring
R Asbestos gasket
S TYPE 316 STAINLESS STEEL wedge pin
T NI-RESIST CAST IRON, TYPE 2, through-port body
U TYPE 316 STAINLESS STEEL solid I-beam wedge
V TYPE 316 STAINLESS STEEL seat rings

Wherever valves are attacked by acids, salt and alkaline solutions, sea water, brine or other corrosive fluids, vapors or gases, "Jenkins Ni-Resist Gate Valves" are *fighting* words.

In a wide range of corrosive and erosive services common to the chemical, food, plastics, marine, petroleum, and pulp and paper industries, these valves have shown a remarkable ability to withstand corrosion and cut valve costs.

The secret of their long, trouble-free service is the combination of Ni-Resist type 2 cast iron and type 316 stainless steel trim, plus Jenkins *extra value* construction throughout. No other gate valves offer this combination for fighting corrosion.

When choosing Ni-Resist valves, let the famous Jenkins Diamond be your guide. Specify "JENKINS NI-RESIST" — for longer valve life. Write us, or ask your Jenkins Distributor for information folder No. 205. Jenkins Bros., 100 Park Avenue, New York 17.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS
SINCE 1864

Sold Through Leading Distributors Everywhere

DU PONT *Petroleum Chemicals* NEWS

Number 80 in a Series of Bulletins for the Petroleum Industry

OCTOBER 1957

Du Pont FOA-2 provides advantages to refiners as well as to their customers

"BRIEF CASE" PRESENTATION WELL RECEIVED BY PETROLEUM INDUSTRY AND ITS CUSTOMERS

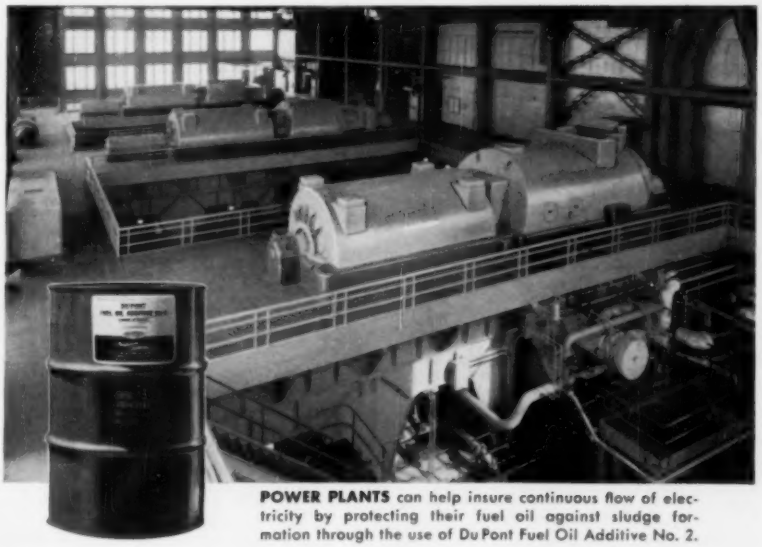
The "Brief Case for Business" presentation was announced in a NEWS ad last January. Since then 500 kits have been put to use, and they are expected to play an important role in this year's Oil Progress Week. Developed by the Du Pont Petroleum Chemicals Division, the "Brief Case" tells an oil industry public relations story in much the same way as the popular "Magic Barrel" has been doing so successfully for nearly five years.

The "Brief Case" presentation, introduced last January 1st, is sponsored by the Oil Information Committee of the API. It tells in a highly dramatic way the importance to the American economy of oil products and of products made from oil. According to OIC estimates, over 1,000 presentations will have been made by November 1 – to club, school and civic groups throughout the country.

Small and low cost

Exhibits in the kit were carefully selected to tell a forceful story. The kit fits compactly into a lightweight, easy-to-carry brief case and costs only $50 complete. If you are not already using the brief case kit, or would like additional kits, any of our Du Pont Petroleum Chemicals Division representatives will be glad to help you obtain them.

The versatility of Du Pont Fuel Oil Additive No. 2 (FOA-2) provides refiners with processing flexibility as well as sales features for their customers. Here's how . . .



POWER PLANTS can help insure continuous flow of electricity by protecting their fuel oil against sludge formation through the use of Du Pont Fuel Oil Additive No. 2.

FOA-2 makes it possible to blend catalytic-cracked stocks with straight-run products and still maintain good storage stability and performance. Because of this, refiners can adjust their inventories of heating and diesel fuels to meet varying seasonal demands. And the storage stability of a catalytic-cracked stock by itself can be increased by the addition of FOA-2.

The additive also helps to upgrade stocks to increase the yield of domestic heating oils, and release straight-run stocks for charging stock.

Protects wide range of products

The stabilizing and dispersant action of Du Pont FOA-2 is highly effective across the whole range of distillate fuel oils. This means that the same additive that retards and disperses sludge formations in home heating oils can be used to help prevent injector-sticking and filter-clogging in all types of diesel fuel – for truck, tractor, marine, industrial, and railway locomotive engines.

With this extremely broad range of usefulness, many refiners are able to realize substantial savings in their overall manufacturing and distribution operations through the use of this single additive.

Benefits residuals, too

Because of the nature of the product, sludge problems with residual fuels can be particularly troublesome. Many of the problems can be readily solved by periodic treatment of the system with FOA-2. But it's even easier to prevent them and eliminate many costly tank-cleaning operations by simply adding a small amount of FOA-2 to the residual fuel before it goes into the storage tank.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

DUPONT *Petroleum Chemicals* NEWS

CONTINUED

FOA-2 Advantages

Many residual fuel users, both large and small, have already found that FOA-2 will keep their fuel storage and supply systems clean and their burners operating smoothly. Thus, substantial savings are made by eliminating costly downtime for cleaning.

For detailed information

To help you benefit fully from FOA-2 in all these applications, we will be glad to send you a comprehensive 24-page book about it.

All the basic information you will need is included in this book—composition and properties, use concentrations, handling and addition methods, performance testing, and a discussion of the benefits of FOA-2 in all its applications.

Many refiners find pre-mixed additives more convenient

A new combination "package" of DuPont Fuel Oil Additive No. 2 premixed with DuPont Metal Deactivator has been offered to refiners during recent months.

We've heard many favorable comments on this new combination from refiners who have tried it. It has proved a convenience to be able to add a single additive with combined properties that guard against practically all the major chemical causes of heating oil and diesel fuel troubles, specifically sludge and gel accumulations.

The new combination is available to you in drums in two different concentrations . . . FOA-208 – 92% FOA-2, 8% DMD; and FOA-212 – 88% FOA-2 and 12% DMD.

You ought to know . . .

JOHN D. ROGERS is supervisor of the jet and aviation fuels research group at the DuPont Petroleum Laboratory, Carney's Point, New Jersey. In this capacity he serves as an aircraft engineering consultant, working closely with the engine manufacturers and Navy and Air Force test centers on evaluation of fuel performance in the latest aircraft. And his staff at the laboratory analyzes trends in military requirements and related commercial developments to help refiners meet present and future demands for aviation petroleum products.

His broad experience has ideally equipped him to provide refiners with competent aid in these fields.

He joined the DuPont Company in 1951 as a senior engineer at the Petroleum Laboratory. He did engine and combustion research on fuels, and worked with refiners on automotive performance studies until 1954. Before coming to DuPont, he did development work on rocket and jet aviation fuels for a major oil company. During World War II, he was with an aeronautical corporation as combustion analyst and design engineer on B-29 engines.

Mr. Rogers received his B.S. degree in mechanical engineering at the University of Delaware. Later he was an instructor at Yale University, specializing in internal combustion engines. He has also a master's degree from Stevens Institute of Technology, and did advanced study of thermodynamics and fluid mechanics at the University of California in Berkeley.

He is a member of the Institute of Aeronautical Sciences, American Rocket Society and the Society of Automotive Engineers. He is active on the Aviation Fuels Technical Committee of the ASTM and the Aviation Fuels Division of the Coordinating Research Council.

LITERATURE AVAILABLE

Here is a partial listing of the many bulletins, reports, booklets, technical papers, and other aids available to you through any of the DuPont Petroleum Chemicals Division offices:

DuPont FOA-2—A comprehensive 24-page book containing all the basic information you will need to have about DuPont Fuel Oil Additive No. 2 for its application in heating, diesel and residual fuels. Fully illustrated with photographs, charts and diagrams A-4966

New DuPont Dry-dye Eduction Probe and No-dust Drumhead—A folder describing and illustrating the revolutionary new dry-dye eduction devices, which make gasoline dyeing a cleaner, faster, and more efficient operation A-2903

DuPont Petroleum Dyes – Includes data on chemical composition and physical properties of the complete line of DuPont Petroleum Dyes. Also spectrophotometer curves, rate of solution tables, military specifications, addition methods and handling recommendations . . . A-2723

Sales Promotional Aids for Dealer Meetings—Describes the many DuPont aids available for dealer meetings. A handy check list for anyone planning dealer meeting programs A-98

You can order by number from the nearest office listed below.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. . . . RAndolph 6-8630
Cleveland 15—25 Prospect Ave. . . . SUperior 1-1363
Denver 2—Petroleum Club Building, 16th & Broadway . . . . . AComa 2-2347
Houston 2—705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17—612 So. Flower St. . MAdison 5-1691
New York 20—1270 Ave. of the Americas . . . COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . LOcust 8-3531
Pittsburgh 22—1 Gateway Center . . . ATlantic 1-2933
San Francisco 4—111 Sutter St. . . . EXbrook 2-6230
Seattle 3—4003 Aurora Ave. . . . . MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. . . . LUther 5-5578
In Canada—DuPont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**—Ontario . . . . . HUdson 1-6461
In Other Countries—Organic Chemicals Department, Export Division, 7447 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962.

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Better Things for Better Living
. . . through Chemistry

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

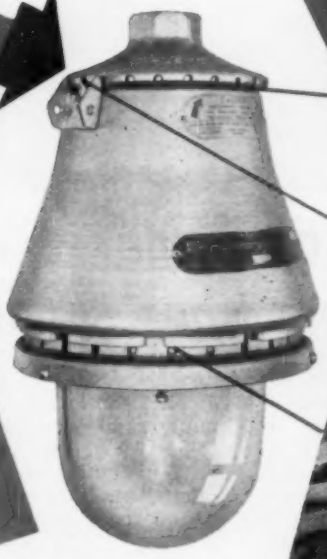
OVER

Printed in U. S. A.

APPLETON "AA-51" SERIES VENTED EXPLOSION-PROOF LIGHTING FIXTURES

Exclusive NEW Anti-Vibration Guard!

Interchangeable Units
Identical diameters "A" on Dome Assemblies permit quick interchange of fixtures with different wattages (from 60 Watt to 500 Watt.



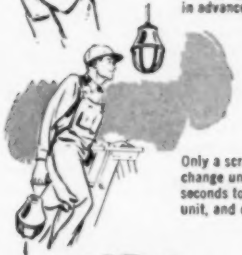
Close-up showing canopy, extra-safe multiple "AA-51" contact threads, and anti-vibration guard with V-shaped metal prong before engaging canopy notches.

Canopy is securely locked against vibration disturbance by positive engagement of V-shaped metal prong in tightly sealed canopy notch. This anti-vibration guard may be quickly released by hand pressure for maintenance.

Similar in action to canopy guard, this close-up shows anti-vibration guard locking globe ring to dome unit assembly. Metal prong in dome unit is securely engaged by notched globe ring to prevent accidental loosening. This anti-vibration guard also may be quickly released by hand pressure for maintenance.

58 Second Relamping

Series "AA-51" stand-by units are ready at an instant's notice for relamping... with handles attached in advance.



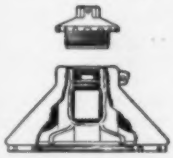
Only a screwdriver is needed to change units . . . and only 58 seconds to climb ladder, change unit, and descend.

Cleaning fixtures, changing burned-out lamps, can be done safely at bench . . . preventing costly shutdowns.

The fixture with "all" the features now sets even greater standards of efficiency and safety!

APPLETON'S new anti-vibration guard on all "AA-51" vented explosion-proof fixtures assures users of positive protection against spark caused mishaps due to vibration conditions. Coupled with multi-thread safety design where a "flame-tight" contact chamber permits servicing *even with the current on*, this new anti-vibration guard demonstrates APPLETON'S continuing quality research program to bring you the finest in electrical products. Check these other features for proof of "AA-51" design leadership and adaptability for your requirements. Write for complete information today.

Sold through franchised wholesalers only



"Full Circle Venting"
Porous metal interior and specially designed hood dissipate heat evenly and safely . . . keep fixture temperature down, provide longer lamp life.

APPLETON ELECTRIC COMPANY
1718 Wellington Avenue, Chicago 13, Illinois

APPLETON ELECTRIC PRODUCTS

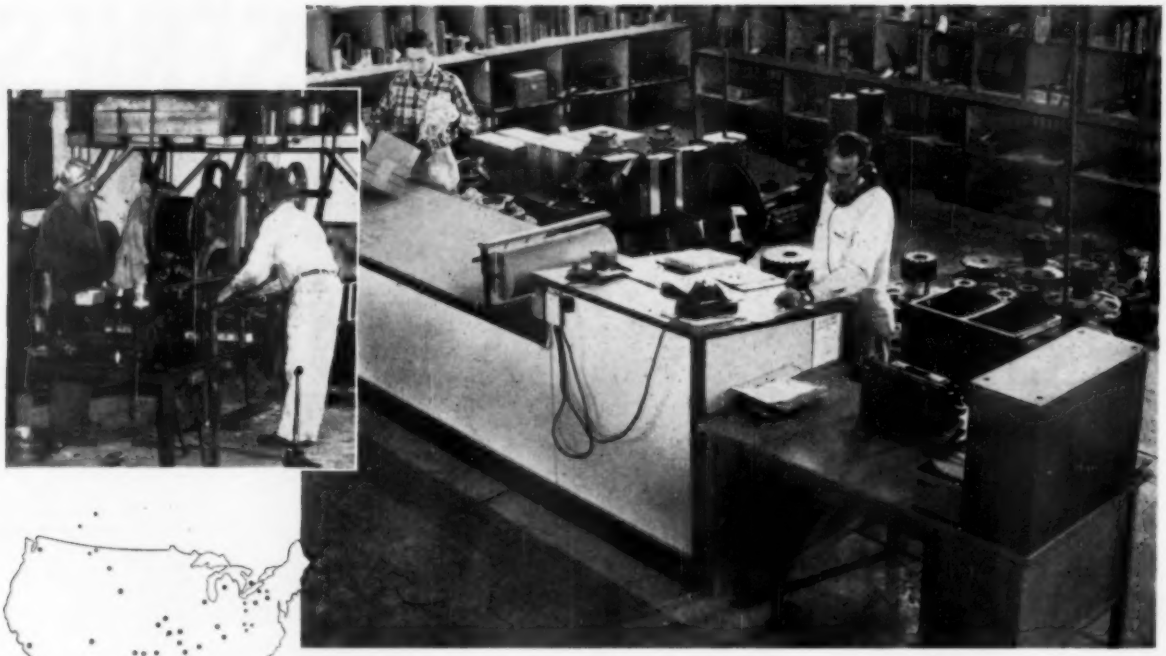
Also manufacturers of:

Industrial Lighting Equipment

Automatic Reslites

"31" Series Connectors

Malleable Iron Unilets



Nearby sales and service teamwork best serves your spudder needs

Here's an up-to-date list of 42 distributor outlets for Bucyrus-Erie spudders. Located throughout the United States and Canada in every major oil field, these well-staffed organizations assure fast, efficient sales and service teamwork. Their experienced, well-trained men are always ready to provide prompt, dependable service on tools, and repairs. Take advantage of their years of drilling know-how, their wealth of cost-cutting ideas, their eagerness to satisfy. They're in business to help you make money . . . to analyze and recommend ways to solve your drilling problems. Preventive maintenance pays dividends, so why not have your distributor representative inspect your machine for needed parts.

Stop in soon at the Bucyrus-Erie distributor nearest you and get the full sales-service story.

48557

FIRST with the FINEST in Spudders

Write, Wire or Phone

BEACON SUPPLY CO. . . . . . Pampa and Borger, Tex.
BECKWITH MACHINERY CO. . . Pittsburgh (East Liberty), Erie, Bradford and Clearfield, Pa.
BUCKEYE SUPPLY CO. . . . . . Zanesville and Wooster, Ohio
BUCKEYE SUPPLY CO. OF KANSAS, INC. . . . . . Wichita, Chase, Arkansas City, Great Bend, and El Dorado, Kan.
CABLE TOOL SUPPLY CO. . . . . Princeton, Ind.
DRILLERS SUPPLY CO. . . . . . Joplin, Mo.
DRILLING AND MINING EQUIPMENT CO. . . . . . Los Angeles, Calif.
GREAT NORTHERN TOOL & SUPPLY CO. . . . . . Billings, Cut Bank and Kevin, Mont.; Casper, Wyo.
IVERSON SUPPLY CO. . . . . . Tulsa, Oklahoma City and Okmulgee, Okla.; Ft. Worth, Dallas, Midland, Odessa and Snyder, Tex.; Artesia and Farmington, N.M.
McJUNKIN CORPORATION . . Charleston, Hamlin and Lenore, W. Va.; Allen and Pikeville, Ky.
OLYMPIC SUPPLY CO. . . . . . Seattle, Wash.
THE STRAKER SUPPLY . . . . . Mt. Pleasant, Mich.

CANADA

LUCEY CANADIAN SUPPLY CO., LTD. . . . . . Calgary and Edmonton, Alta.
NEWFOUNDLAND TRACTOR & EQUIPMENT CO., LTD. . . . . St. Johns, Nfld.
TILLSONBURG PIPE & SUPPLY CO. . . . . . Tillsonburg and Smith's Falls, Ont.

48557

BUCYRUS ERIE

SOUTH MILWAUKEE
WISCONSIN

DISTRICT SALES OFFICES • Atlanta, Ga. • Evansville, Ind. • Dallas, Tex. • Englewood, N.J.

For the petroleum industry...

There's MORE continuous processing with Allis-Chalmers chemical MOTORS and PUMPS

Maximum protection against moisture, acid, alkali, and heat is built into the Allis-Chalmers line of chemical motors. This results in fewer motor stoppages, uninterrupted processing, and more profitable operations.

Special safeguards against breakdowns are standard on Allis-Chalmers chemical motors:

1. All external stationary parts are cast iron.
2. Hex head cap screws, Parkerized for corrosion resistance, are used throughout.
3. Stator gets *five* dips-and-bakes in insulating varnish . . . followed by two coatings of enamel.

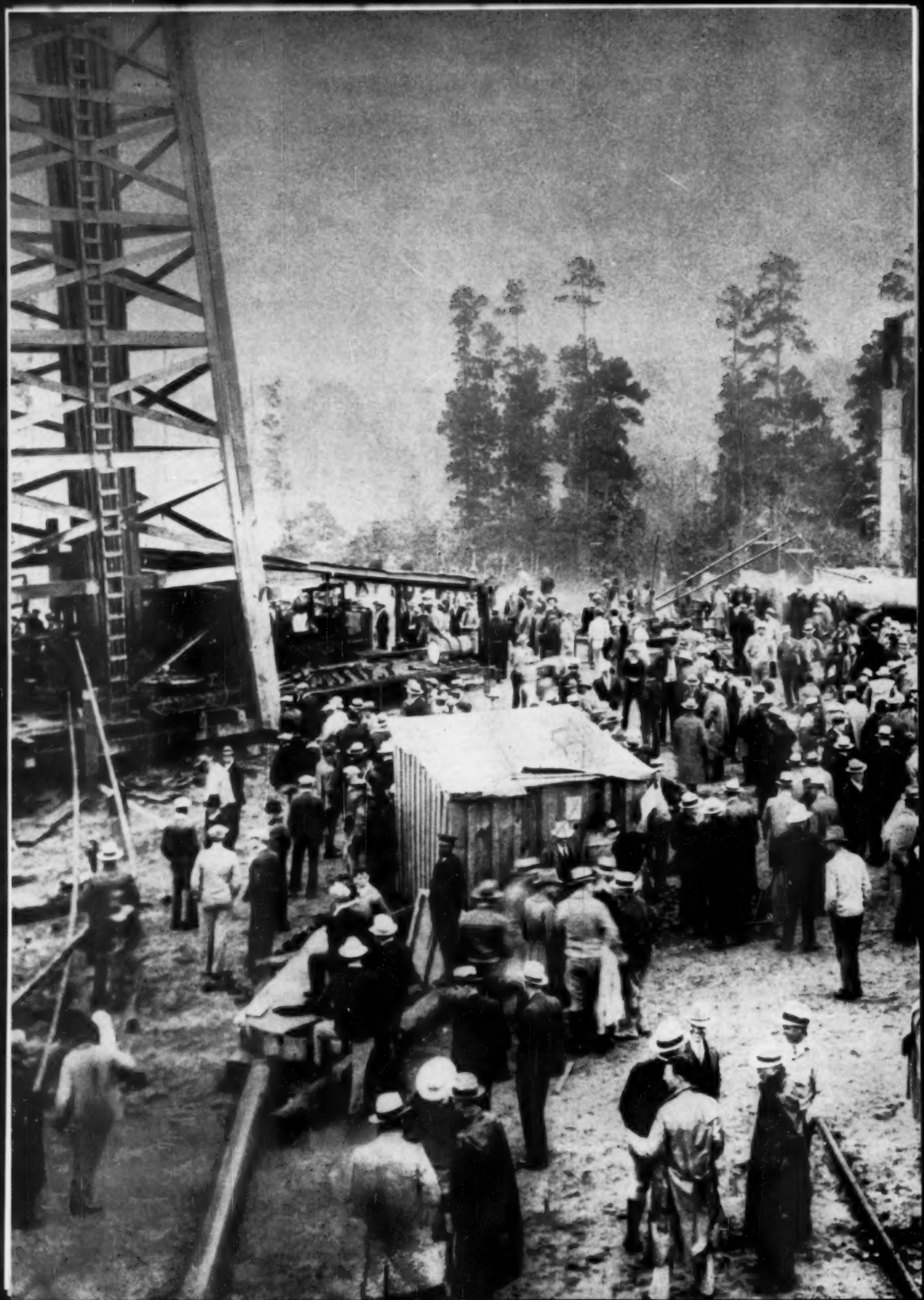
Find out more about the "MORE" in Allis-Chalmers motors and pumps by contacting your A-C office or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wis.

For Fast Delivery, check Allis-Chalmers first! Chemical motors are available in all enclosed designs. Shown here are 20-hp motors driving Allis-Chalmers 5 by 4-in. adapter pumps in a mid-western refinery.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-5168



What Makes a Boom?

An oil boom, or any other kind of boom, springs from an idea . . . a good idea.

Patillo Higgins and Captain Anthony Lucas had one and the Spindletop Boom thus was born.

Dad Joiner had an idea and the great East Texas Field became a reality.

Who knows the extent of oil provinces under the seas? Or how much oil will be eventually produced below 30,000 feet? Booms aren't things that live only in history. They're always around. And more are sure to come.

But, booms are more than just ideas . . . they are actions based on careful planning. And, usually they're the result of more than one idea, more than one kind of action.

Take the Christmas Tree, for example . . . it's a part of the first East Texas boom, too—just as it is a vital part of the 1956 oil industry.

About the same time Dad Joiner made his first unsuccessful try in East Texas, O-C-T opened its doors—in an 18 x 20-foot shop in Houston.

By September 3, 1930, the date the famous wildcatter brought in the historic No. 3 Daisy Bradford, the men of O-C-T had followed up an idea with action.

Before the East Texas boom had a good start, they introduced the first factory-assembled, pretested Christmas Tree.

There had been Christmas Trees before, of course.

But these were often slipshod affairs, assembled on the spot with whatever material was available and noted more for their malfunctions than for performance.

O-C-T took the hit and miss out of well control equipment . . . put it on a mass production basis that guaranteed efficiency, economy and availability.

That was the first boom O-C-T participated in, but not the last.

Other ideas, other firsts followed fast.

The company introduced the first 10,000-pound test Christmas Tree . . . the first 15,000-pound test tree . . . the first casing head with an automatic seal . . . the first and only flow control that gives the advantages of both a choke and a valve . . . the first dual tubing string equipment . . . the first 30,000-pound test tree.

Booms aren't things only in history.

They're always around, although not always as spectacular as Spindletop or East Texas.

And more are to come.

Who knows of the oil provinces that lie under seas hundreds of feet deep?

Who knows of the oil provinces buried under 30,000 and 40,000 feet of earth?

There are booms yet to be written of.

And O-C-T plans to be there with the best equipment in the field . . . not when the booms are history . . . but when they're made.

O·C·T

OIL CENTER TOOL CO.

A SUBSIDIARY of FOOD MACHINERY and CHEMICAL CORP.—Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

***NEVER ANOTHER BOOM** like East Texas perhaps, but somewhere around us there are other booms just waiting to be discovered. This is an East Texas scene when oilmen gathered to watch the Lathrop discovery come in near Longview, extending the field 27 miles from the Joiner well. (Photo from "East Texas Oil Field—The First 25 Years," by James A. Clark, courtesy Texas Mid-Continent Oil and Gas Association.*

Instrumentation News

• *News of instrumentation and automatic control in modern industry* •

BRISTOL EXPANDS

Steps Up Instrument Service With New Branch Factories in Los Angeles and Houston

5 Branch Factories Plus 44 Service Centers Now Speed Instrument Service Throughout U. S. and Canada.

The new branch factories represent a major expansion of existing instrument repair and service facilities in these cities, and surrounding areas. The new branch factories are staffed with thoroughly trained Bristol field engineers and technicians and have all the equipment necessary for manufacturing standard instruments and for completely rebuilding and calibrating any Bristol instrument. (Every such factory-reconditioned instrument carries a "new" guarantee.)

The Los Angeles and Houston branch factories bring the total number of branches to five—others being located at San Francisco, Chicago and Toronto (Bristol Company of Canada, Ltd.).

The new Los Angeles branch factory, located at 6800 East Acco Street, will bring top notch instrument service to the rapidly growing West Coast electronics and aircraft industries. The Houston branch will be of particular interest to instrument users in this Southwestern center of the petroleum and petrochemical industries.

NEW PITTSBURGH HEADQUARTERS

PITTSBURGH, PA.—As part of its overall expansion, The Bristol Company announced a new and enlarged branch office headquarters at 2250 Noblestown Road, this city.

The new office will augment the already outstanding instrument service Bristol has given customers in this area since establishment of the first Bristol branch office here in 1906.

New Los Angeles Bristol Branch Factory

New Pittsburgh Headquarters

New Houston Branch Factory

"ON-THE-SPOT SERVICE" for users everywhere

WATERBURY, CONN.—The recent opening of new branch factories and offices will step up on-the-spot services for Bristol instrument users, wherever located.

Bristol customers services begin long before an instrument is purchased and continue long afterward. Bristol field and application engineers, throughout the U. S. and Canada, are available to recommend equipment best suited to your job.

NO AXES TO GRIND

You are assured of an unbiased recommendation because Bristol makes almost every kind of instrument – full size, miniature, electronic, pneumatic, electric, mechanical. Bristol process instrument specialists are ready to advise you on up-to-the-minute control systems for new tough or unusual processes.

After purchase, you have available on short notice—often within a few hours—a nationwide staff of factory-trained, widely experienced Bristol service engineers. For a reasonable rate, they install, check, adjust and inspect Bristol instruments in your plant. You can arrange to have a Bristol service engineer call at regular intervals to keep equipment in top operating condition.

Complete factory reconditioning is now available at 5 factories: San Francisco, Los Angeles, Chicago, Houston, the main factory at Waterbury, and the Bristol Company of Canada, Ltd., Toronto. Write for full particulars on Bristol instruments or service. The Bristol Company, 120 Bristol Road, Waterbury 20, Conn. 7.25

BRISTOL *TRAIL-BLAZERS IN PROCESS AUTOMATION*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Sun Oil Co. cracking unit at Marcus Hook, Pa.

Refineries Save $3,500,000 with B&W Carbon Monoxide Boilers

B&W Carbon Monoxide Boilers, in oil refineries, are compiling outstanding records. The seven units already on stream have produced, since 1953, savings of $3,500,000 in fuel costs. And every day they are in operation, they continue to save money. Each of these boilers is quickly paying for itself. No wonder a total of 15 units has been ordered to date.

Big fuel savings are achieved because B&W "CO" Boilers put sensible and combustible heat to work. In extended, sustained service they have proved their efficiency, reliability, and economy.

The cracking unit becomes independent of other steam sources. The boiler can be operated at all times, whether or not the cracking unit is on stream.

B&W engineers, experienced in meeting differing refinery conditions, can design a B&W "CO" Boiler to fit your specific requirements, for any steam pressure and temperature, for any size cracking unit. The Babcock & Wilcox Company, Boiler Division, Dept. OGJ 4, 161 East 42nd Street, New York 17, N. Y.

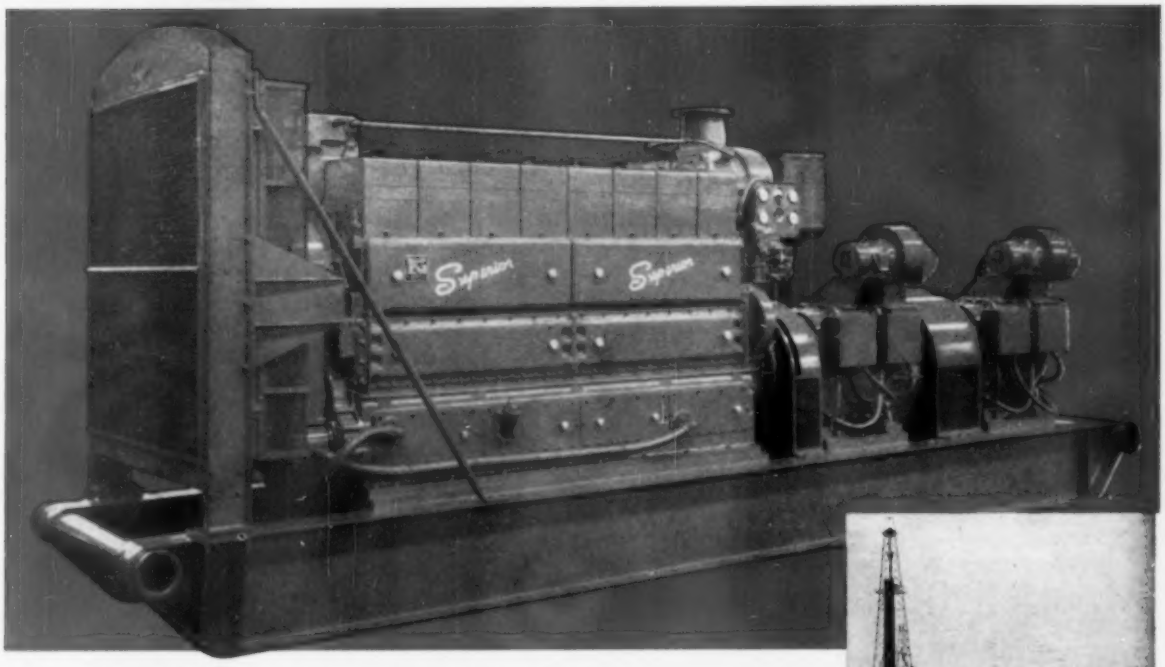
G-832-CO

BABCOCK & WILCOX

BOILER DIVISION

Esso Creole Petroleum selects

White DIESEL White's Superior Diesel-Electric



Lighter, extremely simple, more powerful drilling rig power plant!

Creole Petroleum Corporation, a Venezuela affiliate of Standard Oil Company (New Jersey) chose White's Superior Diesel-Electric power for drilling operations on Lake Maracaibo in western Venezuela. The complete power package, including three 900 HP Superior engine-generator sets mounted on the 180′ long by 70′ wide barge, will dependably provide a total of 2700 HP. From simplified controls, the driller can direct 2,000 HP to the platform draw works or 2,300 HP to the mud pumps. White's diesel power concentration achieves simplicity, compactness and light weight. The favorable power to space ratio obtained through electric motors behind the draw works means Creole Petroleum can use a standard size platform and yet have ample power for deep drilling.

Creole's barge power components consist of 3 engine-generator sets, 5 drive motors, and simple controls. White's well known Superior oil field engine and rugged 400 KW generators in tandem make up an engine-generator set. Large drive motors are rated 625 HP continuous and 1000 HP intermittently. Greatly simplified controls allow application of power where required, either to draw works, mud pumps, or to both when pumps and rotary are operating.

White's range of other diesel-electric drilling power packages combines the Superior oil field engine and rugged 300 to 550 KW generators. Largest drive motors are rated 1000 HP continuous and 1250 HP intermittently. All components are stocked, standard production items, ready for prompt delivery.

WRITE TODAY FOR COMPLETE INFORMATION...

White Diesel

WHITE DIESEL ENGINE DIVISION

THE WHITE MOTOR COMPANY Plant and General Offices: Springfield, Ohio

In your gas-scrubbing processes... Call on JEFFERSON

Pipelines directly into your plant, with glycols and ethanolamines available at the turn of a valve! A nice "pipe dream" for the purchasing and plant personnel! Next best is Jefferson service in tank cars, tank wagons and drums from convenient distribution points at Port Neches and Houston, Texas; Chicago; Charlotte; Los Angeles; and Tenafly, N. J.

These high-quality gas-scrubbing chemicals are backed by the knowledge and experience of our technical staff. For prompt service, just call your nearest Jefferson office. **Jefferson Chemical Company, Inc., 1121 Walker Ave., Houston 2, Texas.**

Essential Chemicals from Hydrocarbon Sources

Jefferson
CHEMICAL COMPANY, INC.

HOUSTON • NEW YORK • CHICAGO • CLEVELAND • CHARLOTTE • LOS ANGELES

Years of effective mud conditioning prove high performance of PALCOTAN

DEVELOPED THROUGH PALCO RESEARCH

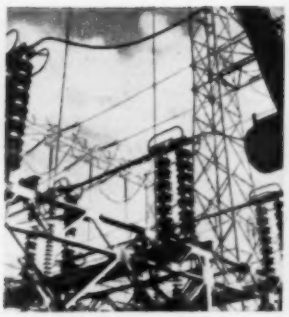
Over four years of continuous large scale commercial use in important drilling areas throughout the world now back up the findings of over a decade of field and laboratory research. *Palcotan*, the unusual chemical extract of California redwood bark, has "come of age" as a low cost, stabile, easy to handle compound to control viscosity, gel strength and water loss in drilling muds. Now, for the first time, following the third in a series of plant expansions, *Palcotan* is available in sufficient quantity to meet all requirements. So if previous shortage has prevented your use of *Palcotan* in the past, plan now to put it to work. Exceeding specifications for quebracho in many applications, *Palcotan* is particularly efficient in low concentrations, is readily soluble in cold water, may be added with or without caustic, and comes in a non-toxic coarse powder form packed in convenient multiwall 50 lb. bags. Write today for full information.

Available through oil field and mud service organizations

Write for Bulletin No. 4-01 describing the properties and operating advantages of Palcotan

THE PACIFIC LUMBER COMPANY
100 Bush Street, San Francisco 4, California

STEEL, with its giant equipment, uses Cities Service lubricants in mounting quantities. The list of Cities Service customers reads like a "Who's Who" of steel.



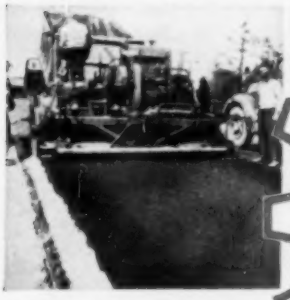
ELECTRIC POWER companies use Cities Service Diesel Lubricating Oil to set low-cost power generating records. Proof again of the high quality of Cities Service Oils.

MACHINE SHOPS find Cities Service Cutting Oils the answer to longer tool life and greater precision. Cities Service makes cutting oils for every job requirement.

PAPER requires huge quantities of highly refined wax. The best is Cities Service Pacemaker . . . used for milk cartons, wax paper, straws and many other products.

MINING is both a quantity and quality user of lubricants. Cities Service tailors precision lubricants to serve this basic industry, symbolized by the famous Mesabi Iron Range.

FARMING is more and more a mechanized industry, and more and more an important Cities Service customer. Farming uses more petroleum than any other industry.



ROAD BUILDING calls for enormous quantities of Cities Service petroleum products—all the way from fuels to lubricants to asphalt topping. Future demand looms larger and larger, as America launches the greatest highway building program in history.

Geared to the needs of fast rolling American Industry

AVIATION, with its mounting requirements of higher octane gasolene and jet fuels, finds Cities Service a major supplier. With its ultramodern refinery facilities, Cities Service is capable of producing aviation fuel components in huge quantities.

CITIES SERVICE

WONDERLY ADDS THREE HD-6's

rates them "great"...

Wonderly Construction Company, Long Beach, California, one of the largest oil field pioneering companies in the Pacific Southwest, operates a big fleet of crawler tractors and tractor equipment. This company is getting outstanding performance from their Allis-Chalmers crawler tractors and just added three new HD-6G tractor shovels. Here are some enthusiastic comments from Wonderly's top supervisory and maintenance people.

'on performance...

"In my opinion, the HD-6 can outwork anything in its class and be leagues ahead in economy. It can walk on pavements without doing damage—a big point of value to us.

"Both the Allis-Chalmers HD-6 and HD-16 are great pieces of equipment. They are comparable, and in many ways far superior, to anything on the market and will outperform competitive units on many jobs."

G. W. "Red" Goldsmith, Gen. Mgr.

"That old HD-5 up at Santa Paula has paid for itself many times over and is performing as well today as when we bought it. It's not as powerful as the new 6's, but on lighter jobs it performs wonders."

Meredith Taylor, Supt.

on maintenance...

"The Allis-Chalmers 1,000-hour lubrication period is a tremendous timesaver and advantage in the inaccessible areas we work in.

"With drill sites and equipment spread over such a wide area, it would run our costs into the stratosphere if we had undependable units or machines that needed constant attention. I know for a fact that Allis-Chalmers equipment has saved us thousands of dollars."

Lewis Thompson, Head Mechanic

on design...

"I think the front-end buckets on Allis-Chalmers tractors beat anything on the market today."

Russ Lovinger, Supt.

"Allis-Chalmers has the best front-end loader in the business, bar none. It's faster, more maneuverable and less trouble to maintain than other units."

Thompson

"That double-reduction final drive is a great thing. It gives smooth power output. In my opinion it's superior to anything I know of in current use."

Lovinger

"The torque converter on the HD-16 gives you more and smoother power and less wear than anything I've ever seen. I'm responsible for maintenance and believe me, I'm sold!"

Thompson

on dealer service...

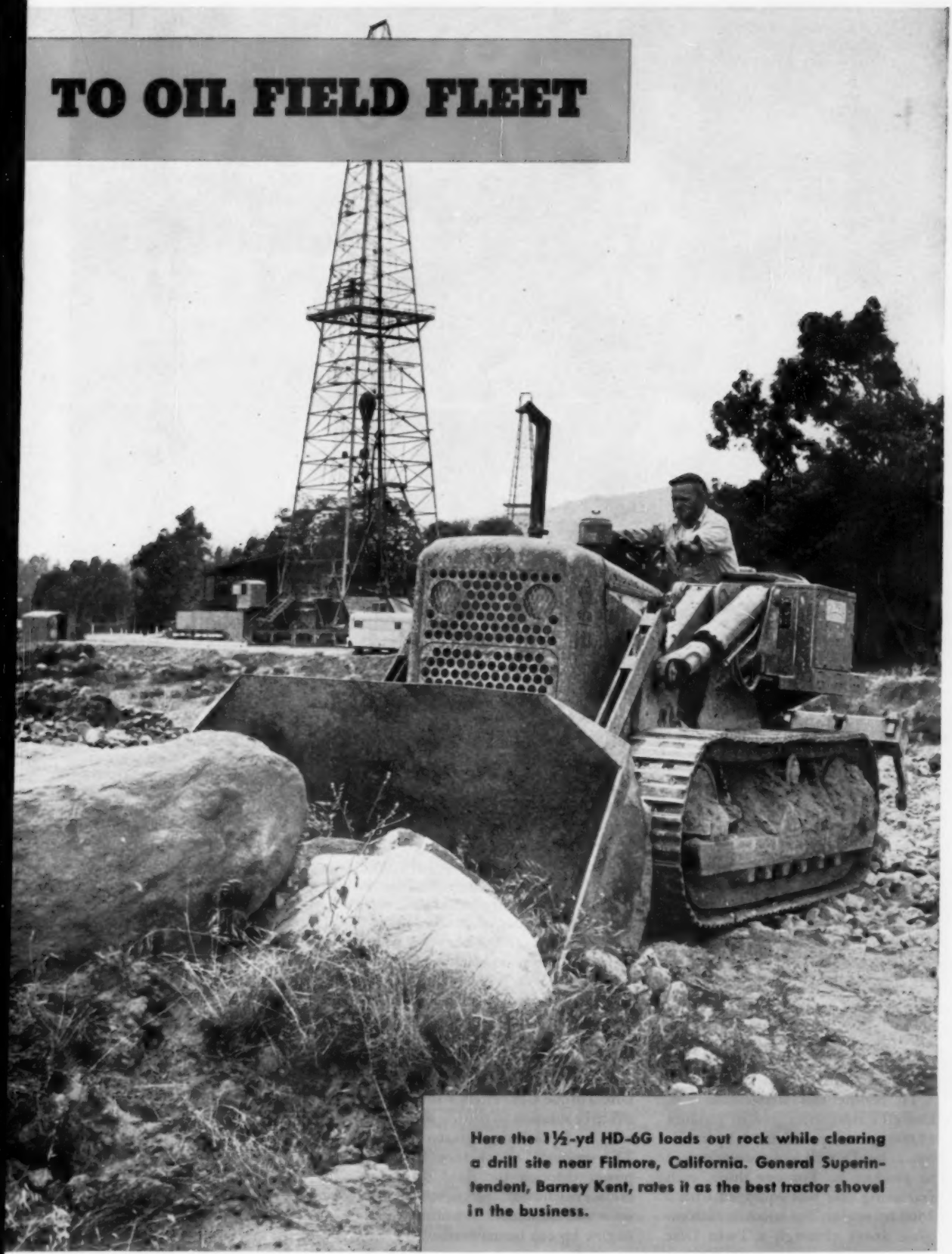
"Not only are Allis-Chalmers tractors 'tops,' but the service we get from the dealer is excellent. We work our equipment seven days a week, and we can depend on help if we need it."

M. C. "Bill" Wonderly, President

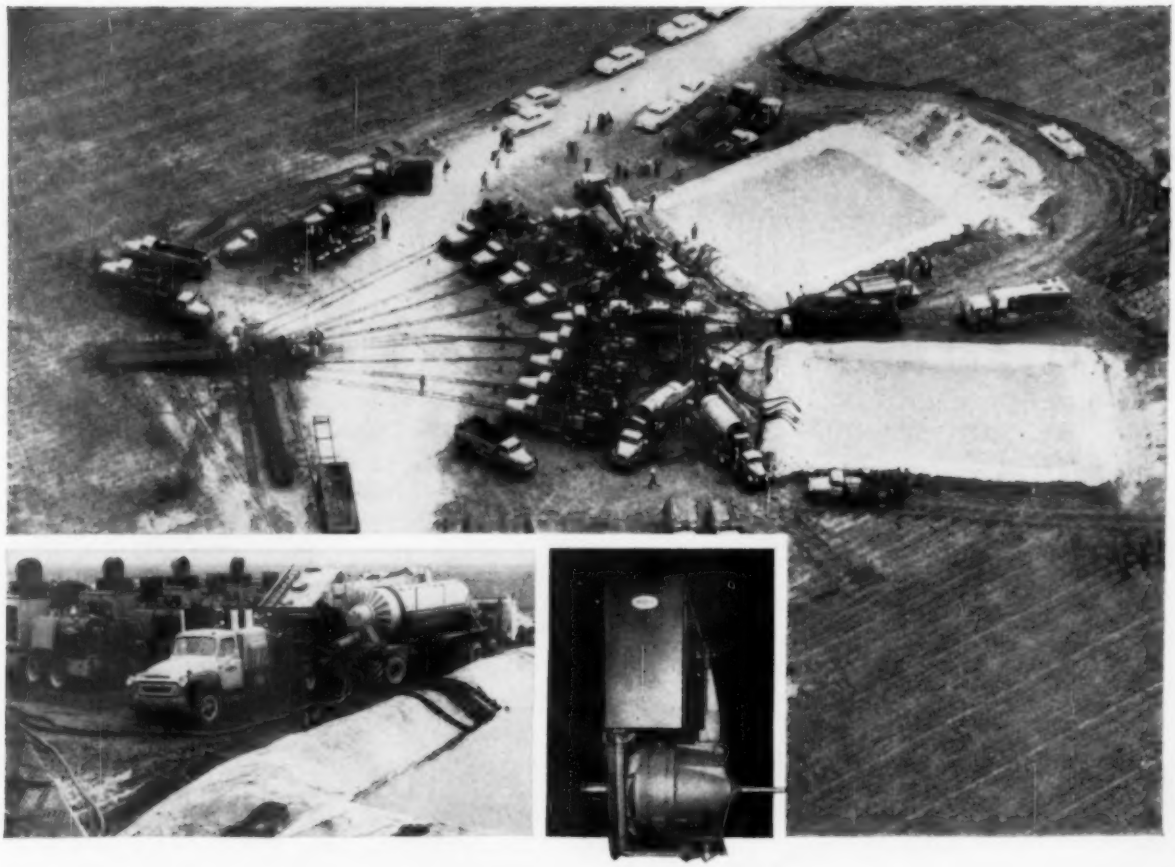
Find out what Allis-Chalmers equipment can do on your oil field jobs. Get the full story from your nearby Allis-Chalmers dealer. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wis.

ALLIS-CHALMERS *Engineering in Action*

TO OIL FIELD FLEET



Here the 1½-yd HD-6G loads out rock while clearing a drill site near Filmore, California. General Superintendent, Barney Kent, rates it as the best tractor shovel in the business.



New fracturing record set with torque converter drives

When a large southwestern oil company called in Dowell Incorporated, Tulsa, for fracturing a Borden County, Texas, oil well, 41 Dowell engineers arrived prepared for a major job.

With 29 pieces of equipment, two newly built polyethylene film-lined pits, 329,000 gallons of water and 225,000 pounds of sand, the men pumped a staggering 3000 gallons a minute into the well at 3500 psi. The result was that Dowell easily broke its own previously established world fracturing record.

To handle this tremendous job, Dowell's equipment had to produce 15,000 gross hp and 6250 hydraulic hp . . . but Dowell had the equipment to produce it. For one thing, each fracturing unit was equipped with a 1500-hp engine. For another, each engine drove through a Twin Disc 16,000 Series Three-Stage Torque Converter. Thus regardless of the varying loads and pressures, the torque converters permitted the engines to operate in their most efficient rpm range and produce rated hp. They also provided more efficient operation because the power units were indirectly compounded by the load.

This, however, is only one of many oilfield applications where Twin Disc Torque Converters really prove their worth. Drawworks, rotary tables, mud pumps—whatever your power application problem, you'll find Twin Disc Torque Converters a simple but effective solution to cutting operating costs and producing greater profits. The smooth, shock-free flow of power through the fluid drive increases machinery life, reduces engine wear and minimizes downtime. Full engine hp can be maintained regardless of load . . . and torque multiplication up to 6:1 (three-stage) is available whenever the load demands it.

Take advantage of the many cost-saving features offered by Twin Disc Three-Stage or Single-Stage Torque Converters. See your local equipment dealer or Twin Disc representative or write to Twin Disc Clutch Company, Racine, Wisconsin; Hydraulic Division, Rockford, Illinois.

TWIN DISC

TWIN DISC

Torque Converters

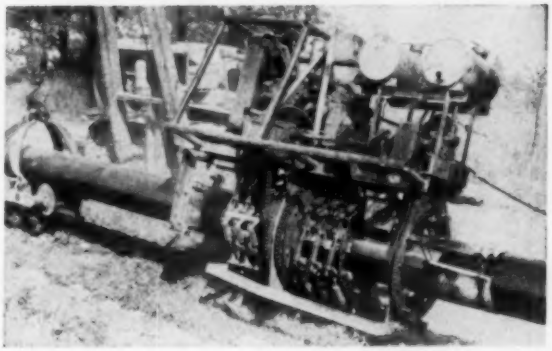
(Left) NO-OX-ID and NO-OX-IDized Wrapper application by Traveliner. (Right) NO-OX-ID kettle.

3-PIECE OUTFIT FOR WELL-DRESSED PIPE

This carrier pipe is being well dressed for years of uninterrupted service underground. A 3-piece outfit—cleaning machine, dope kettle and Traveliner—does the job.

The dressing? NO-OX-ID Coating and NO-OX-IDized Wrapper—a combination that provides chemical-mechanical protection against corrosion and destructive soil action. NO-OX-ID is applied hot or cold by hand or machine...over the ditch or at the mill. No noxious fumes. You save on material because less NO-OX-ID coats more pipe per day. NO-OX-ID Coating and Wrapper combinations shield against corrosion attack.

On your next transmission or distribution line coating job, consult with your Dearborn Pipeline Engineer. Ask him to recommend the NO-OX-ID combination best suited to your requirements. Cost is reasonable and the protection long lasting. The best dressed pipe is NO-OX-ID PROTECTED!



Cleaning and priming prior to coating.

Mail coupon for factual information on NO-OX-ID Coatings and NO-OX-IDized Wrappers

Dearborn NO-OX-ID®

Specify NO-OX-ID combinations for long-term protection

Dearborn Chemical Company
Dept. OG-NO, Merchandise Mart Plaza
Chicago 54, Illinois

☐ Send me NO-OX-ID Coating Combinations literature
☐ Have a Dearborn Pipeline Engineer Call

Name.....*Title*.....

Company.....

Address.....

City.....*Zone*.....*State*.....

Ski lift operators stress safety when it comes to buying wire rope. Too many lives are at stake. So they buy . . .

A Safe Lift

Even though you don't operate a ski lift, false economy can be costly in your rope purchases, too. For a rope failure can cause personal injury . . . wreck your equipment . . . throw off your entire work schedule . . . and affect employee morale. Yes, a "bargain" wire rope may save you money, yet cost you your peace of mind. Don't take a chance. Buy a rope that's a quality rope—buy Wickwire Rope.

WICKWIRE ROPE
A CF&I PRODUCT

CF&I

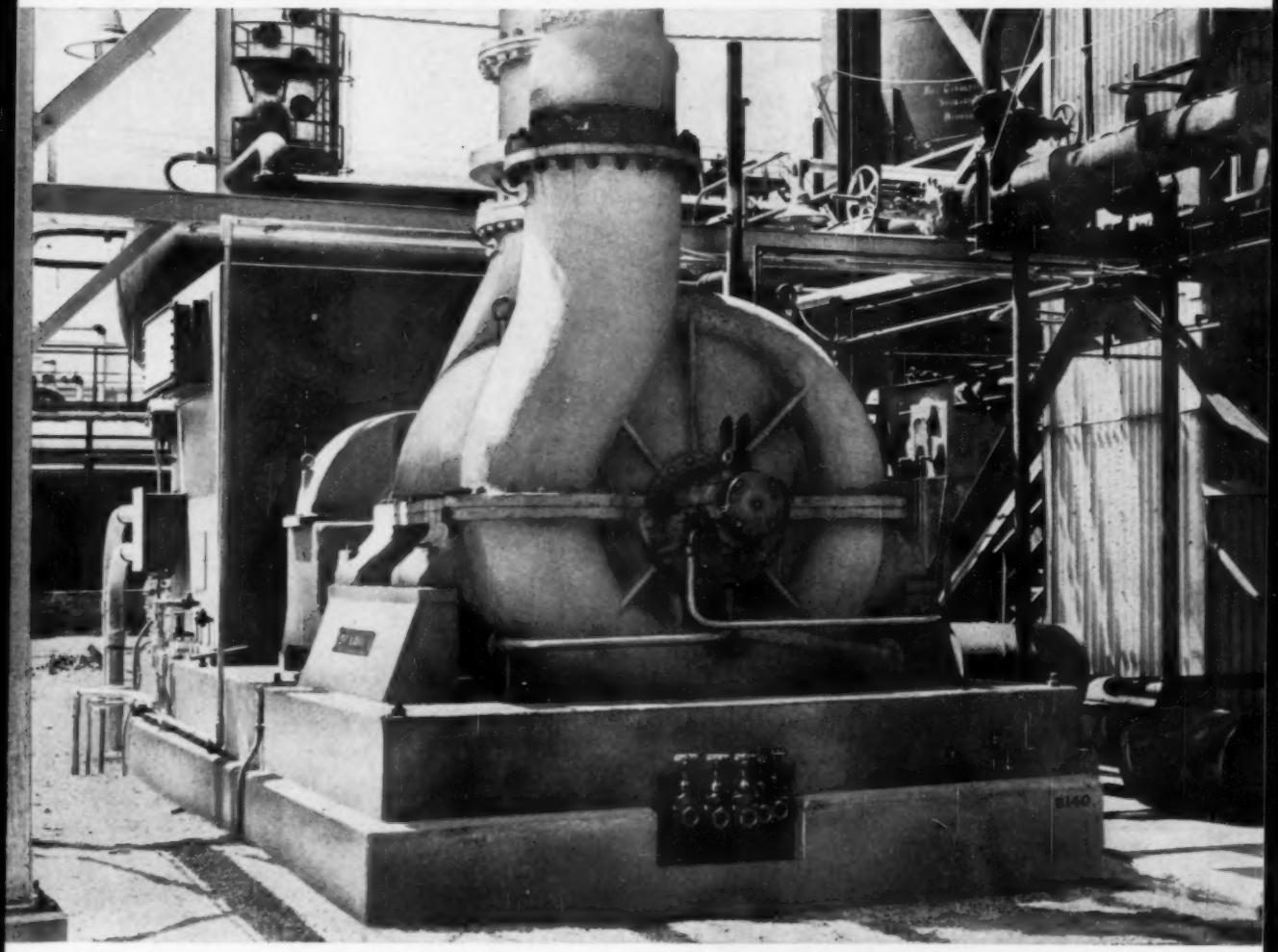
LOOK FOR THE YELLOW TRIANGLE

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

5050

THE COLORADO FUEL AND IRON CORPORATION — Denver • Houston • Odessa (Tex.) • Phoenix • Salt Lake City • Tulsa
PACIFIC COAST DIVISION—Los Angeles • Oakland • Portland • San Francisco • Seattle • Spokane
WICKWIRE SPENCER STEEL DIVISION — Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) • New Orleans
New York • Philadelphia

Another **DE LAVAL** *combustion air compressor dependably serves refinery cat cracker*



On stream at the Coffeyville, Kansas plant of the Cooperative Refinery Association, this De Laval Centrifugal Compressor delivers 24,100 cfm of air. Inlet pressure is 14.0 psia, discharge pressure 38.9 psia. Compressor output is controlled with adjustable inlet guide vanes.

This De Laval main air compressor is driven by a 2500 hp, 1800 rpm motor. Shaft speed is increased to 4800 rpm through a De Laval double helical speed increasing gear.

Cooperative Refinery Association is only one of many refiners who have specified De Laval Compressors. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. Rugged De Laval centrifugal compressors perform dependably in heavy-duty continuous operation. De Laval has more than 40 years of experience in solving gas compression problems.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

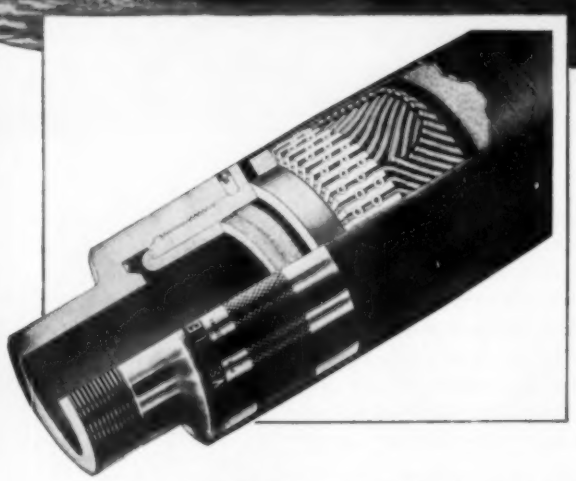
DL-303

on the "scorpion"...

the Rotary Hose is

Thermoid

POWERFLEX

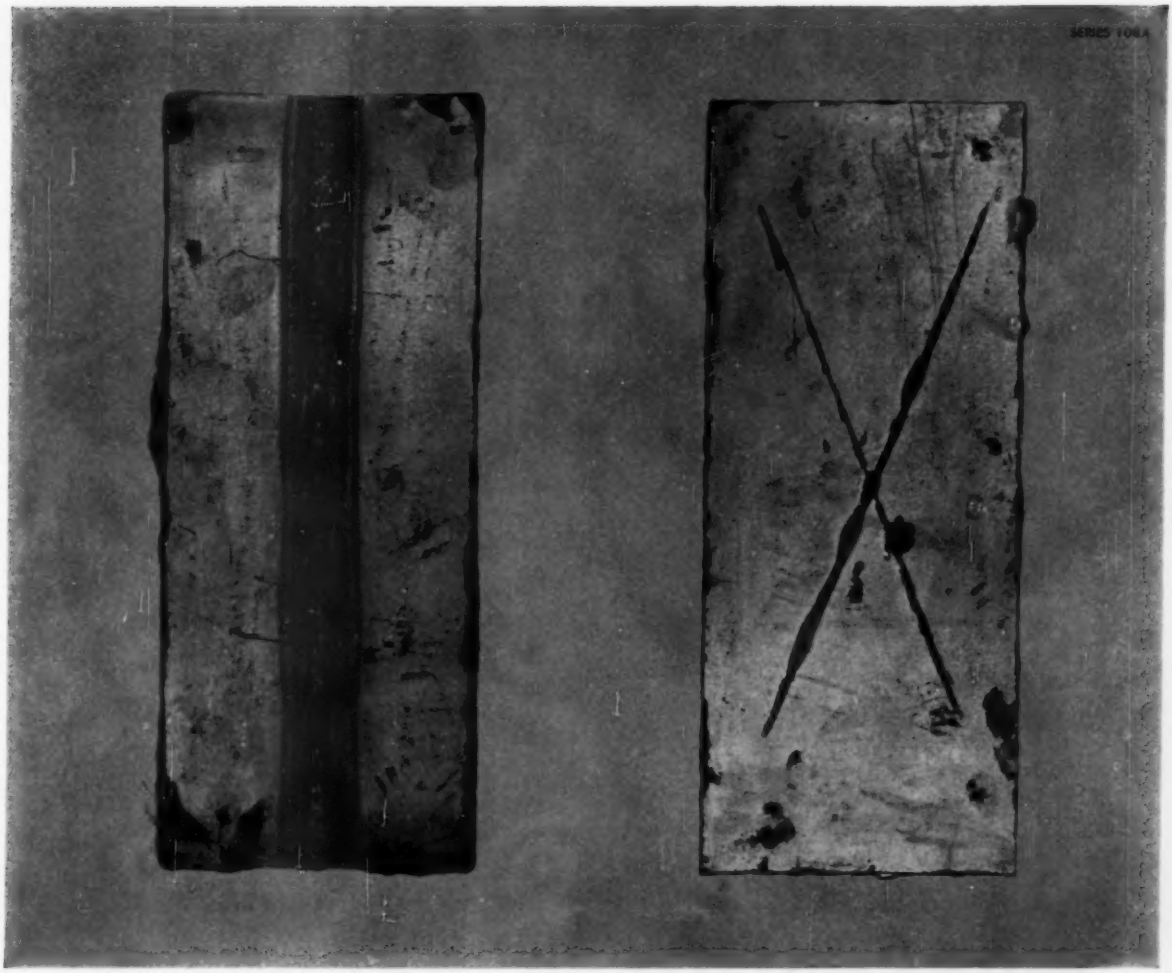


The patented full flow coupling at the left is just one reason why the Scorpion is equipped with Thermoid Powerflex Rotary Hose. It's an integral part of the cable assembly—cannot leak or pull off. The cable itself is made up of *33 miles of high tensile steel-wire* wrapped and counter wrapped. And the tube and cover of Powerflex Hose are made with oil and abrasion resistant Neoprene, reinforced with impregnated multi-ply woven fabric.

You'll also find Thermoid Suction and Discharge Hose and Thermoid Multi-V Belts "aboard" the Scorpion for the same reason—superior quality construction. Order Thermoid Oil Field Products from your nearest supply store or Thermoid warehouse.

Thermoid

THERMOID COMPANY, TRENTON, NEW JERSEY, NEPHI, UTAH
Warehouses: HOUSTON, OKLAHOMA CITY, ST. LOUIS, CASPER, LOS ANGELES



CORROSION'S FOCAL POINTS are easy to detect with a new Amercoat testing method using iron and caustic indicators in a saline gelatin bath. On the welded and scored steel panels shown above after test, unworked surface areas turned red to indicate cathodic properties; but the weld, scores and edges turned blue (here shown blackened) to reveal themselves as anodic corrosion breeders. Rivets, threads, crevices and abrasions also show anodic under test. Unless such areas are effectively sealed from moisture, oxygen and ions they will erupt as focal points of corrosion cells.

How to protect "trouble spots" against corrosion

Ask a corrosion engineer where metal corrosion is likely to attack first. Chances are that he will name rivets, threads, sharp edges, angles, crevices and welds. These are the areas of stress concentration, work hardness, fissures and abrasions. They tend to be anodic and actually breed corrosion. And although they warrant increased protection, conventional coatings pull away from their sharp profiles and leave them inadequately covered.

Amercoat No. 87, a true vinyl mastic, protects these spots in a single coat 10 mils thick, whereas other coatings fail to build 5 mils in three coats. It cuts maintenance painting costs up to 50% because you don't have to re-erect staging and scaffolds for additional coats, and you get results that last.

No. 87 combines the time-tested chemical and weather resistance of vinyl coatings with the thickness of mastic, yet it is easily sprayed with standard equipment over a suitable primer. Available in white, gray, black and aluminum. Use it for enduring protection at lower cost per square foot per year. Complete details mailed on request.—Amercoat Corp., South Gate, Calif.

AMERCOAT Corporation, Dept. CJ
4809 Firestone Blvd., South Gate, Calif.

Please send me your latest information on Amercoat No. 87.

Name_____

Position_____

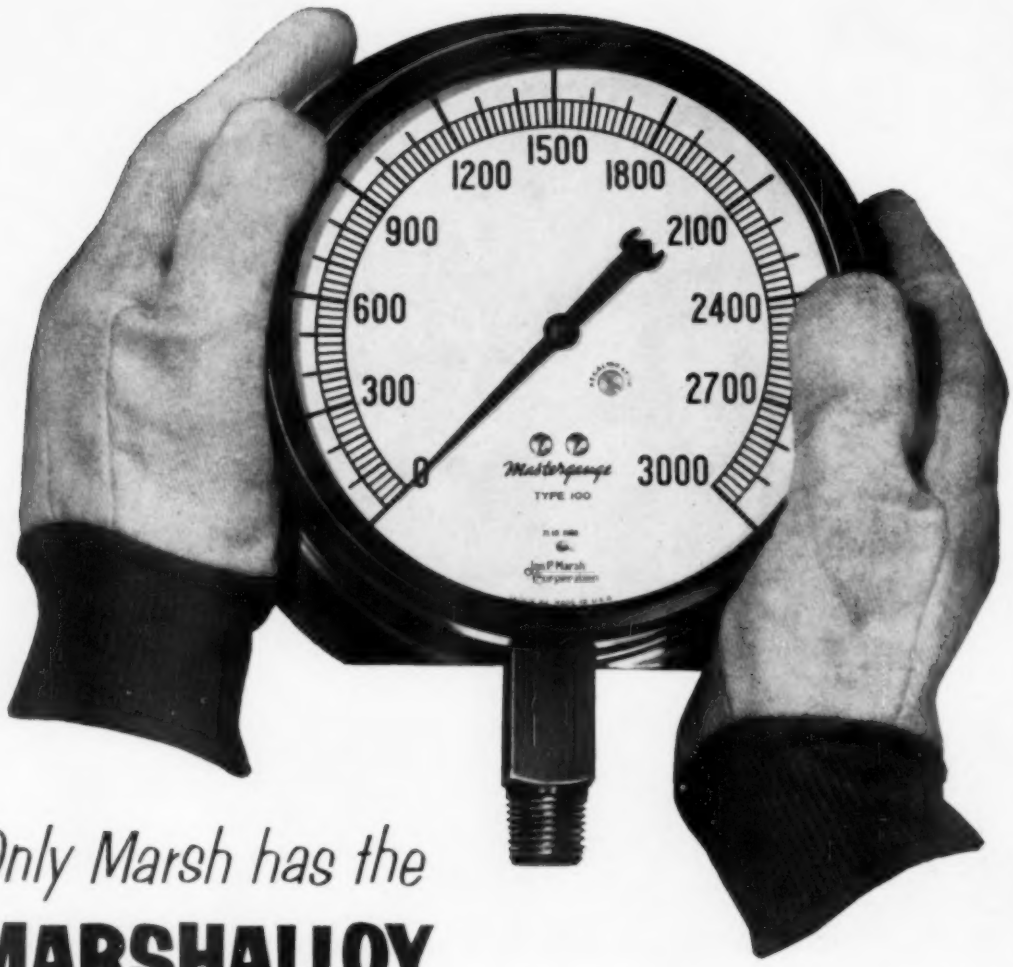
Company_____

Address_____

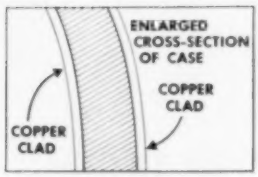
City_____ Zone_____ State_____

Amercoat® CORPORATION

EVANSTON, ILLINOIS • KENILWORTH, NEW JERSEY
JACKSONVILLE, FLORIDA • HOUSTON, TEXAS



Only Marsh has the **MARSHALLOY CASE**



The strength of steel; the corrosion resistance of solid copper . . . that's the Marshalloy copper-clad case.

Four times stronger than cast iron
One-third lighter

There's nothing temperamental about a pressure gauge . . . provided it's built right and given proper protection. The basic units of Marsh Gauges—socket, tube and movement—are known for the care given to their manufacture. Such units deserve the best protection . . . and *get it* in the Marshalloy case. Here is a steel case of boiler-plate-thickness, heavily clad with copper inside and out . . . lighter, but many times tougher . . . protected against the ravages of corrosion. It is available only in Marsh Gauges.

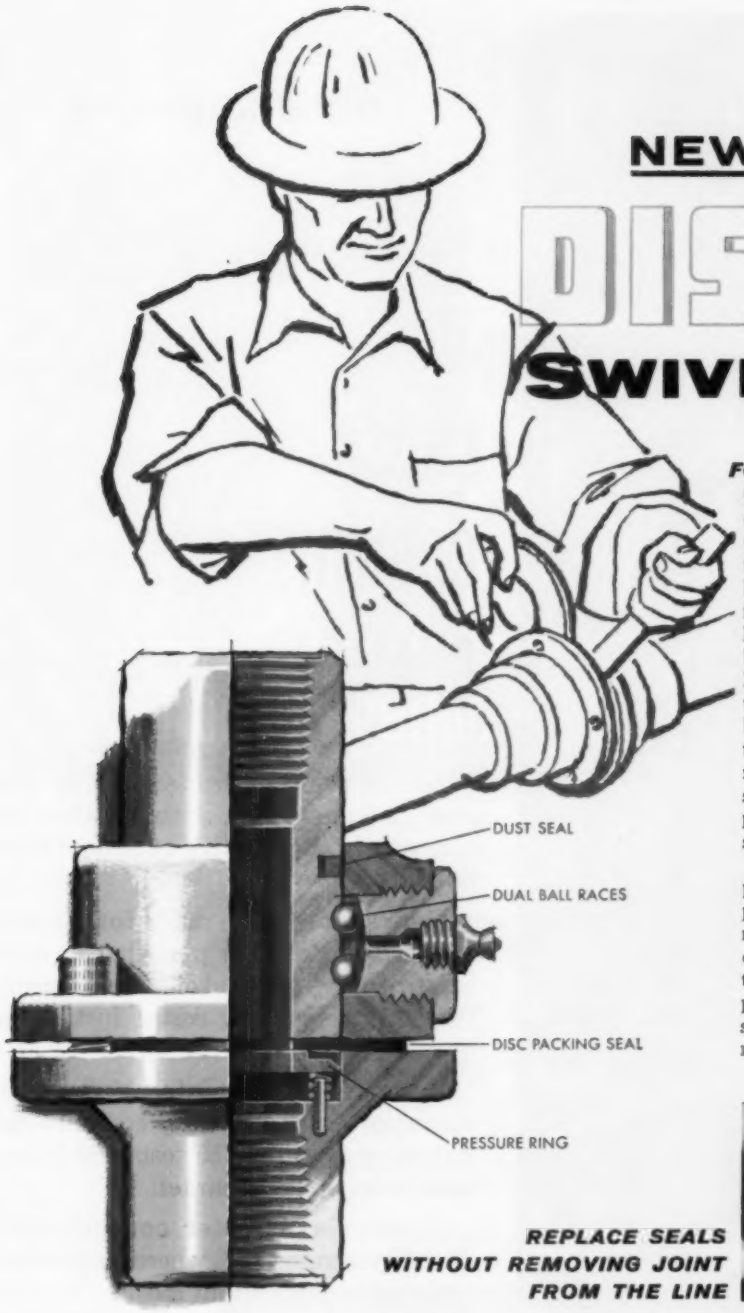
MARSH GAUGES

MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.*
Dept. L, Skokie, Illinois

Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

PRESSURE GAUGES • THERMOMETERS • WATER REGULATING VALVES • HEATING SPECIALTIES

NEW CHIKSAN DISCPAK SWIVEL JOINTS



REPLACE SEALS WITHOUT REMOVING JOINT FROM THE LINE

FOR STEAM AND HOT GAS SERVICE

Created specifically for service on lines employed in steam and hot gas service, the Chiksan Discpak embodies a new construction design which permits packing units to be replaced without removing the joint from the line. The outer housing of the Discpak is cut apart at the packing chamber and both ends are flanged at the cut. Four allen-type cap screw bolts are used to secure the flanges. A disc-seal, housed between the two members, provides a fluid-tight seal between rotating and stationary members of the Discpak Swivel Joint. A spring loaded pressure plate holds the packing in sealing position against the swiveling member.

The new Discpak has a maximum temperature rating of 600° F. and a maximum pressure rating of 300 psi. All turning movement in the Discpak takes place on a double row of precision ball bearings. Write today for literature and prices. If your plant or equipment lines utilize hot gas or steam, it will pay you to know about this new field-proven Discpak swivel joint.

To replace the disc-seal, simply remove four allen screws and spread line slightly with a flat metal bar.

CHIKSAN

CHIKSAN COMPANY, 330 No. Pomona Avenue, Brea, California

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

fmc

Please rush me a copy of your new Discpak Bulletin

NAME_____

COMPANY_____ TITLE_____

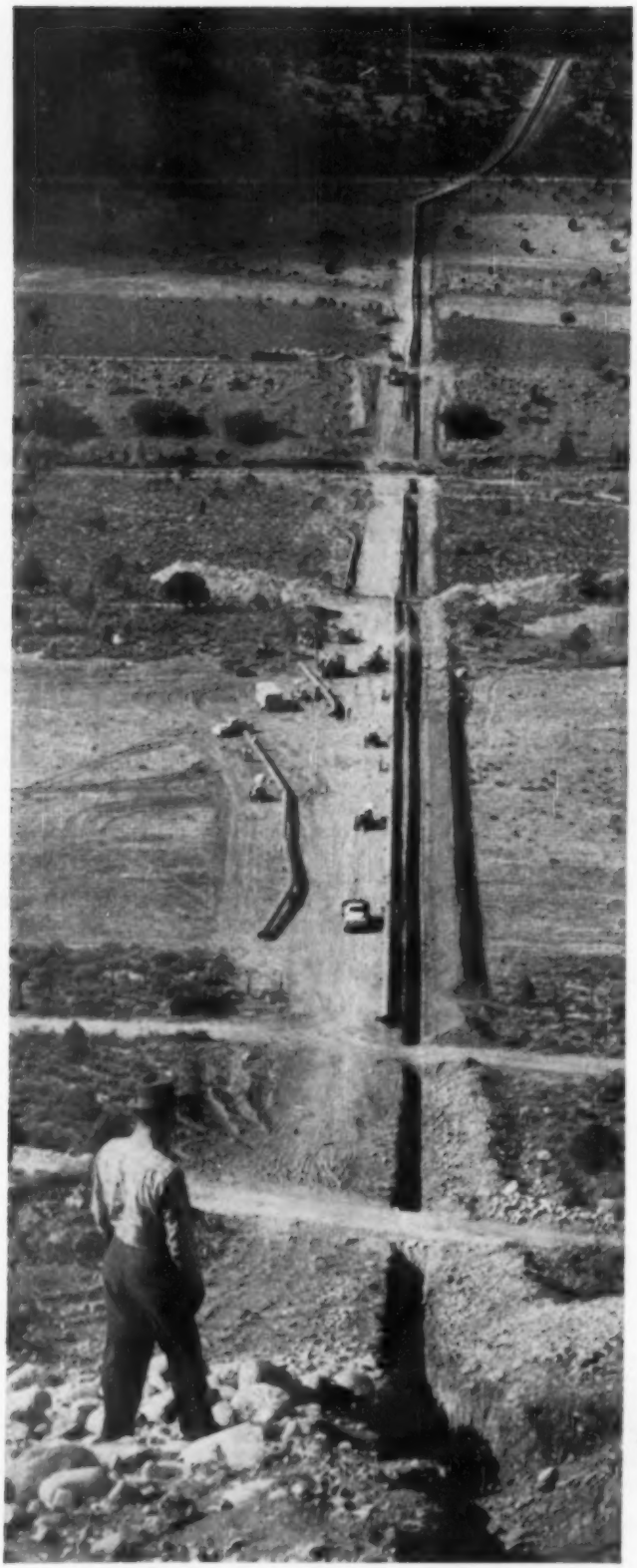
CITY_____ ZONE____ STATE_____

Dept. 310

SEND FOR BULLETIN

New Discpak Bulletin 100 describes in detail the many features of this new swivel joint including full mechanical specifications.

57-26



CROSS COUNTRY CHAMP!

When the going gets rough and the miles start stretching out . . . that's when you appreciate the quality of Kaiser Steel line pipe.

Here's pipe that's made for rigorous conditions. *Precision* pipe that in every length assures the kind of true uniformity that makes handling easier, installation quicker.

Kaiser Steel's fully-integrated western operation assures quality control—permitting no less than 52 tests and inspections from mine to market.

Result: in diameter, concentricity, ductility, strength . . . wherever accuracy and performance count most . . . you can count on pipe of Kaiser Steel to pay off for you in the field.

Kaiser Steel

Steel Mill Products: plates • hot rolled strip and sheet • cold rolled strip and sheet • tin plate • continuous weld pipe • electric weld pipe • alloy and carbon bars • bar shapes • structural shapes semi-finished steels • pig iron • ingot molds • coke by-products • **Fabricating Division:** steel fabrication for construction, aircraft, missile and other industries • expanded fusion weld pipe reinforced concrete pipe • tanks • For specifications, write: **KAISER STEEL CORPORATION** • **Los Angeles** • **Oakland** • **Seattle** • **Portland** • **Phoenix** • **Denver** • **Tulsa** • **New York**

In Crowded Waterways . . .

RCA
CR-105B RADAR

. . . or Open Seas

For Safer Navigation — Accurate Position Finding

RCA CR-105B Small Boat Radar is the choice of workboat operators with an eye to all-around efficiency and top performance. Here's why:

Accuracy—a big, bright 10-inch scope provides sharp, detailed presentations ranging from 50 yards to one mile for close-in navigating . . . 2, 4, 12 and 32 mile ranges on the open sea. Sharp horizontal beam produces high resolution.

Compactness—space saving design ideal for small craft where space is always at a premium. Indicator requires only 2 square feet of deck space; antenna is lightweight.

Economy—low power drain plus 7 kw peak power means lower operating costs with no sacrifice in efficiency. And installation costs are less—no waveguide run necessary.

Ruggedness—completely watertight, built to last and last with the year-in, year-out quality performance found in all RCA Radars.

Simplicity—easy to read, easy to interpret, easy to service—easy for all hands to become proficient radar operators in a short period of time.

Let us send you free information on how RCA Small Boat Radar can help you get more efficiency at less cost in workboat operations.

RCA Radiomarine

RADIO CORPORATION OF AMERICA

RADIOMARINE PRODUCTS • 75 VARICK STREET, NEW YORK 13, N.Y.

Tmk(s) ®

RCA "Workhorses" for the Workboat Fleet

RCA Depth Recorders are sensitive, accurate navigational instruments. Record depths, warn of rocks, wrecks, other underwater hazards.

Model LAZ-17

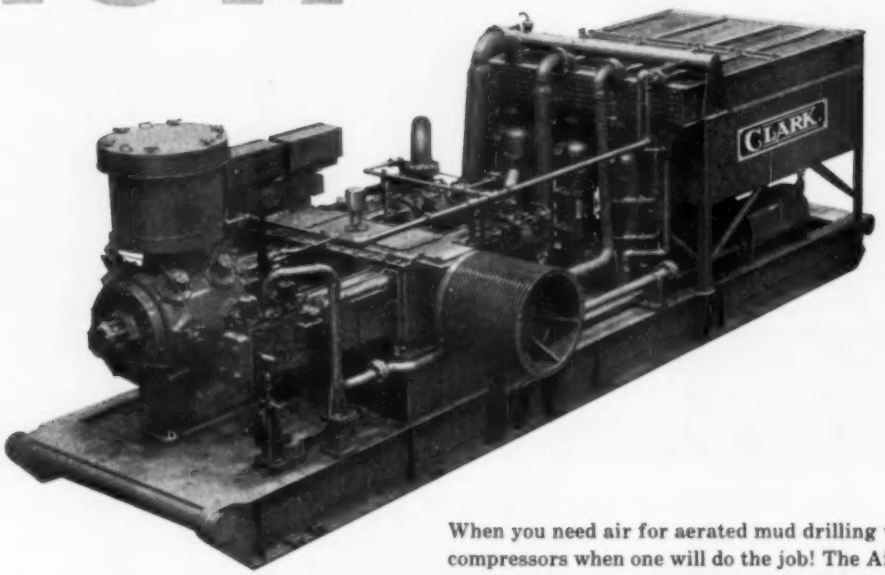
For use on all types of commercial vessels and larger pleasure craft, RCA Radiomarine VHF Model ET-8058 Radiotelephone equipment is designed for marine communications in the 148 to 174 mc band.

Model ET-8058

To keep you in touch with home port offices, other fleet units. With Model ET-8050 Radiotelephone you talk ship-to-shore, between ships; calling and distress frequency.

Model ET-8050

NOW all the air you need for drilling from one compressor

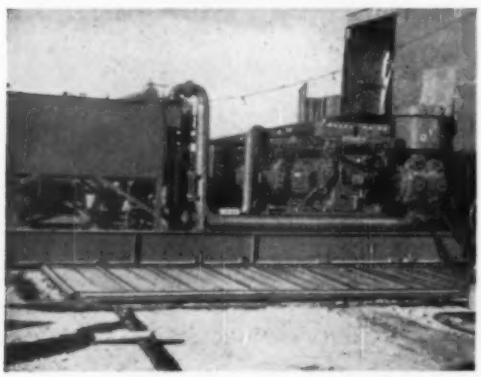


When you need air for aerated mud drilling why use a dozen compressors when one will do the job! The Air-Pac packaged air compressor has proved highly successful in field service.

The Air-Pac is a completely automatic 500 horsepower compressor, belt-driven off the rig's compound. The Air-Pac will automatically maintain any desired discharge pressure between 500 and 1500 psi. An automatic controller also holds the input horsepower steady over the complete range of pressures to eliminate engine stalling. The balanced/opposed design of the compressor means you don't have to fuss with it when you install it. Set it on timbers . . . it won't "walk" away. There is nothing intermittent about the Air-Pac either . . . use it for one or 5000 hours.

Low pressure units are also available for air drilling, incorporating all the features of the high pressure aerated mud unit. For a packaged air compressor that's just as rugged as the rest of your rig... be sure you look into the Clark Air-Pac.

"On the job." Notice that AIR-PAC is not bolted down. Strut rods to rig maintain belt tension.



CLARK BROS. CO. **OLEAN, NEW YORK**

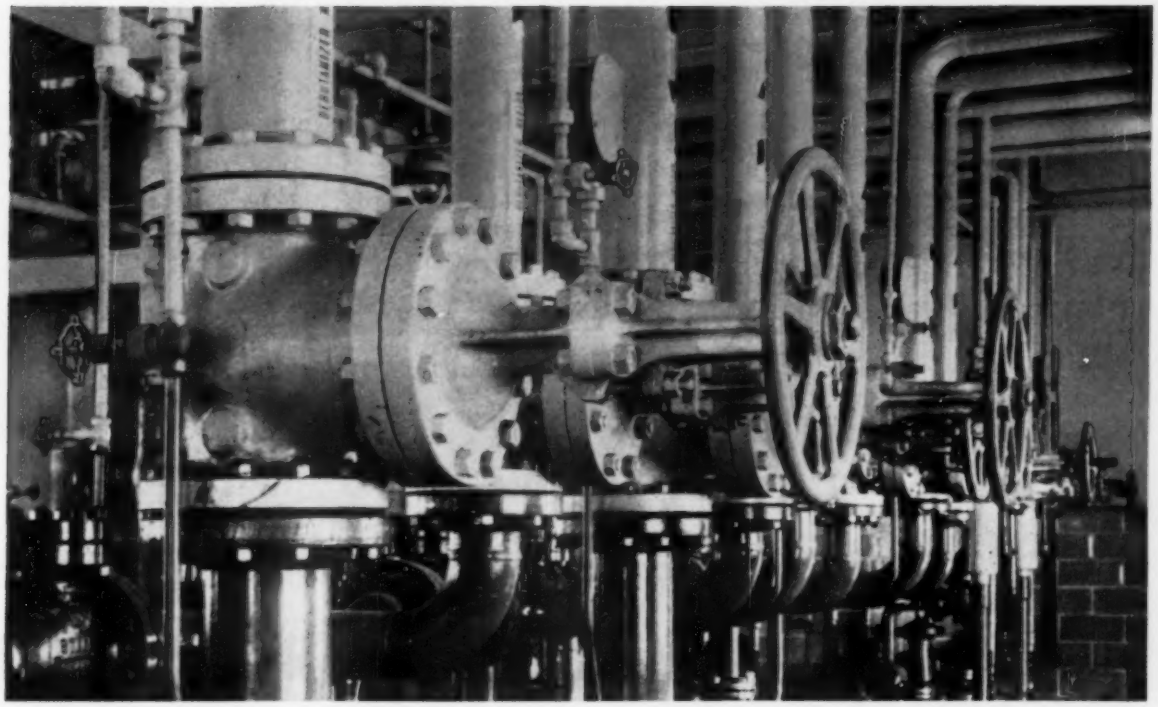
One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK **Air Drilling Compressors**

Don't Hedge on Quality When You Buy Steel Valves...

Maintenance costs can gobble up your savings in a few months!



LUNKENHEIMER QUALITY is no longer a luxury—it's your vitally needed insurance against today's sky-high maintenance expense. Labor rates are going still higher . . . "downtime" costs are multiplying . . . repair charges are rocketing up—with no relief in sight. Today, it pays to buy the *best valves you can get,* with no hedging on quality. Your purchase of Lunkenheimer Steel Valves is an investment that pays worthwhile dividends in maintenance savings . . . year after trouble-free year. The Lunkenheimer Company, Box 360, Annex Station, Cincinnati 14, Ohio.

The cost of a LUNKENHEIMER VALVE
Gets smaller...and smaller...and smaller...
with each passing year of dependable service

A check on the cost of maintaining your cast steel valves will prove this point.

STEEL • BRONZE • IRON • PVC

L-1096-2

LUNKENHEIMER
QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES

Under the most familiar emblem in the industry—the Mack bulldog—are the powerplants that are sparking the major swing to Mack in the large-capacity truck field. Mack Thermodyne® Diesel engines, for example, have set record after record for fuel economy and long life in fleet after fleet.

Macks earn more . . . get more done . . . because

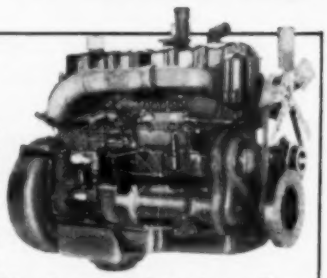
PART FOR PART, MACK TRUCKS ARE THE BEST BUILT

Take Mack-built engines!
Mack gasoline and diesel engines are designed expressly for the trucks that are winning world-wide fame for superior performance.

Power? Mack gasoline engines range from 107 to 206 hp, produced at conservative speeds. Mack diesel engines give 170 hp at 2100 rpm . . . 205 hp with turbocharging. *Stamina?* Mack engines often clock up to 200,000 miles and more without major overhaul. *Fuel economy?* Ask any Mack owner—we'll give you names.

And only Macks have Mack-built engines! Only Macks have the incomparable Mack-built transmissions, axles, cabs and frames. In fact, no other truck is built like a Mack, stands up like a Mack, or has the low-upkeep, high-performance, *higher* earning power of a Mack. Mack Trucks, Inc., Plainfield, New Jersey. In Canada: Mack Trucks of Canada, Ltd.

Here's what makes Mack engines the finest of their kind



Timing gears that never wear out. Husky crankshaft with large main and crank bearings for extra strength and stiffness, connecting rods angle-split for withdrawal through cylinders. Hollow crankpins for smoother, cooler running. Unmatched heat transfer achieved with full length water jackets, plus applications of jet-directed water flow at valve ports and sodium-mercury cooled exhaust valves where needed. Exclusive Niferite alloy for valve-seat inserts. And many other features for superior operation.

And, *in addition*, on Mack Thermodyne Diesel engines . . . Exclusive Synchrovance (on 170-hp engines) which automatically advances or retards fuel injection for fast, sure starts and smoother running. Precision-built, exceptionally rugged, multiple-unit injection pump. Optional air starting and exhaust braking that increases engine retardation by 50%.

4694

MACK
first name for
TRUCKS

DOW CORNING CORPORATION

Silicone News

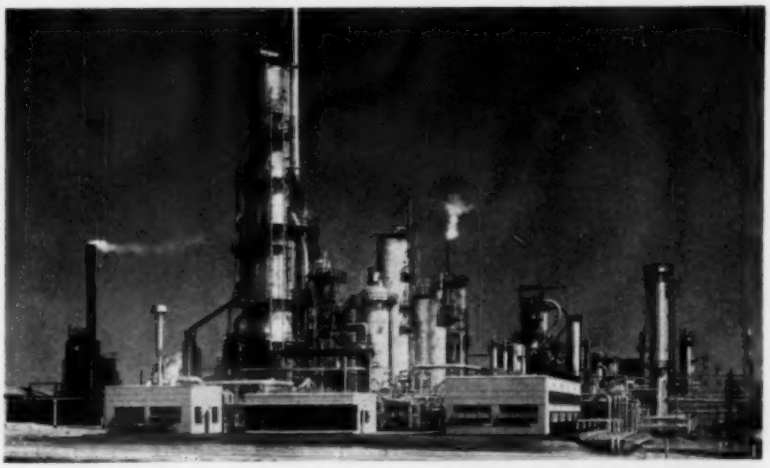
FOR PETROLEUM MEN No. 2

REDUCE GREASING SCHEDULES

Silicone lubricants can solve many a lubricating problem . . . even under desert conditions.

Exceptional heat stability and good resistance to oxidation and corrosive chemicals led Arabian American Oil Company to select a silicone lubricant for the stems of Hammel-Dahl diaphragm valves handling salt water in Near East installations.

Aramco found that Dow Corning 44 Grease kept the valve stems in excellent working order, and cut relubrication schedules appreciably. Results were so good that they now use this silicone grease in a host of well, pipeline and refinery applications. Maintenance costs have been reduced and important inventory economies realized by standardizing on 44 Grease for a variety of jobs. *No. 5*



HOW TO CUT MAINTENANCE WITH SILICONE PAINTS

Here's how one refinery made its plant a veritable tourist attraction, and at the same time made substantial cuts in maintenance costs, by using heat and weather resistant silicone finishes.

Keenly aware of the value of public relations, the Cosden Petroleum Refinery at Big Spring, Texas, painted its entire plant in a bright silver and gold color scheme, with gleaming green, red, and black trim. However, no ordinary paint could take the 300 to 900 F surface temperatures on stacks, furnaces, crackers, and similar units. Several expensive repaintings per season were needed.

Then, in the spring of 1953, Cosden tried a silicone aluminum finish on their huge catalytic cracker. The paint, made with heat resistant Dow Corning silicone resins, was formulated by the Cactus Paint Company. It did an amazing job, retaining a "like new" appearance for three years, despite the heat of the cracker. Consequently, Cosden began specifying silicone based paints for all its high temperature applications.

Cosden has saved a lot of paint and painting time, and the public is being treated to a refinery so attractive that the local citizenry point it out with pride. *No. 4*

Now: More Production With Silicone-Rewound Motor

Could you use more horsepower from your present motors? Here's an easy, economical way to get it.

To obtain a desired increase in production from existing equipment, it was first necessary for Leonard Refineries of Alma, Mich., to speed the feed of catalyst to a cracker. But their 35 hp, 3600 rpm motor couldn't handle any more load. And a larger motor would mean expense and delay.

Solution: Leonard had the old motor rewound with Dow Corning silicone insulation. Silicone insulation allows a motor to work harder without danger of burnouts. Rewinding took only a few days, and the total cost of the rewind was far less than that of a new motor. The rewound motor delivers the needed horsepower; the catalyst conveyor now runs 22% faster, increasing cracker throughput. *No. 6*

Send Coupon Today

DOW CORNING CORPORATION - Dept. 8422a
Midland, Michigan
Please send me 4 5 6

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COMPANY _____

STREET _____

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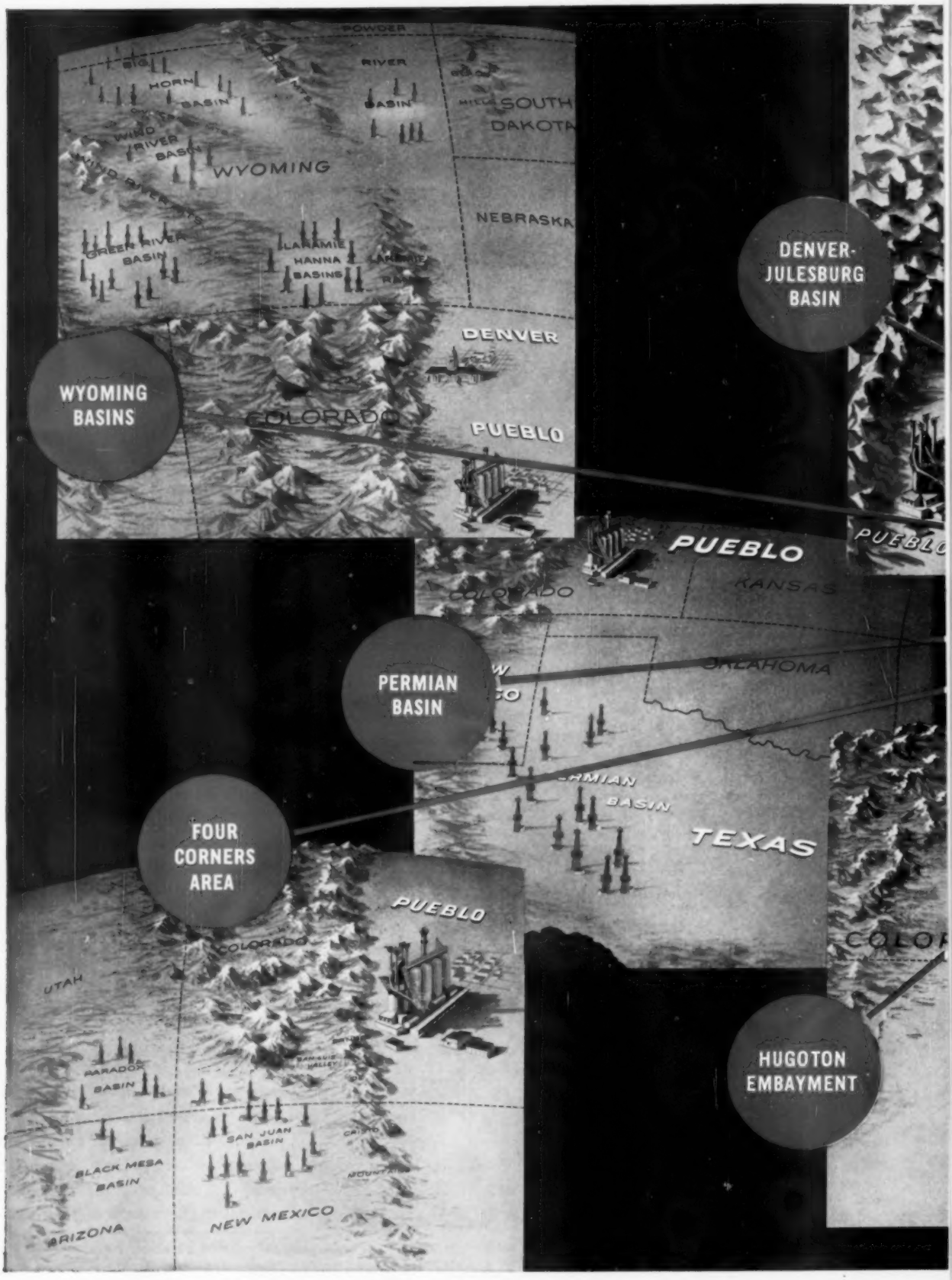
Canada: Dow Corning Silicones Ltd., Toronto; **Great Britain:** Midland Silicones, Ltd., London; **France:** St. Gobain, Paris


WYOMING BASINS
DENVER-JULESBURG BASIN
PERMIAN BASIN
FOUR CORNERS AREA
HUGOTON EMBAYMENT
WYOMING
NEBRASKA
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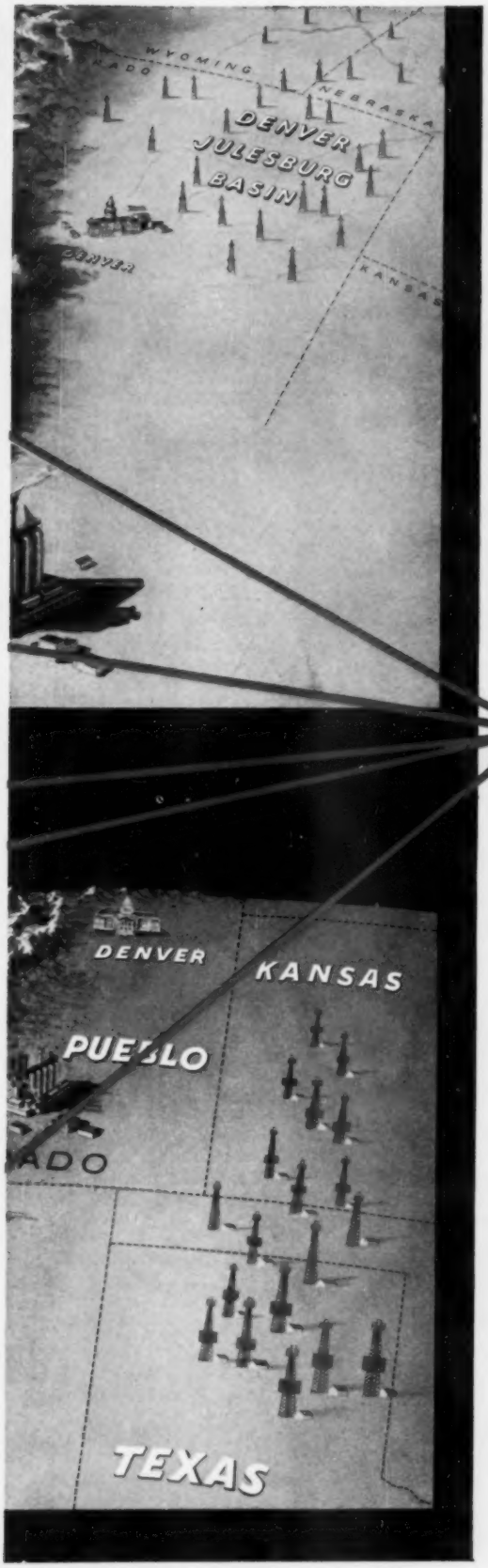
BASIN



CF&I SEAMLESS CASING and TUBING...

right in the middle of it all

Why is CF&I Seamless Oil Country Casing and Tubing so popular in all of the oil and gas producing and exploration areas shown on this map? The answer's not just one thing but several. It's the way CF&I is centrally located so that superior service is assured . . . the way CF&I assures top-quality casing and tubing by operating one of the world's most modern seamless tube mills. Another big reason is that the men of the oil country know that CF&I is always trying to give them the materials and service they want.

CF&I Seamless Oil Country Casing and Tubing meets or exceeds API STD 5A specifications. It is available in 2-3/8" through 9-5/8" O.D.

CF&I SEAMLESS casing and tubing

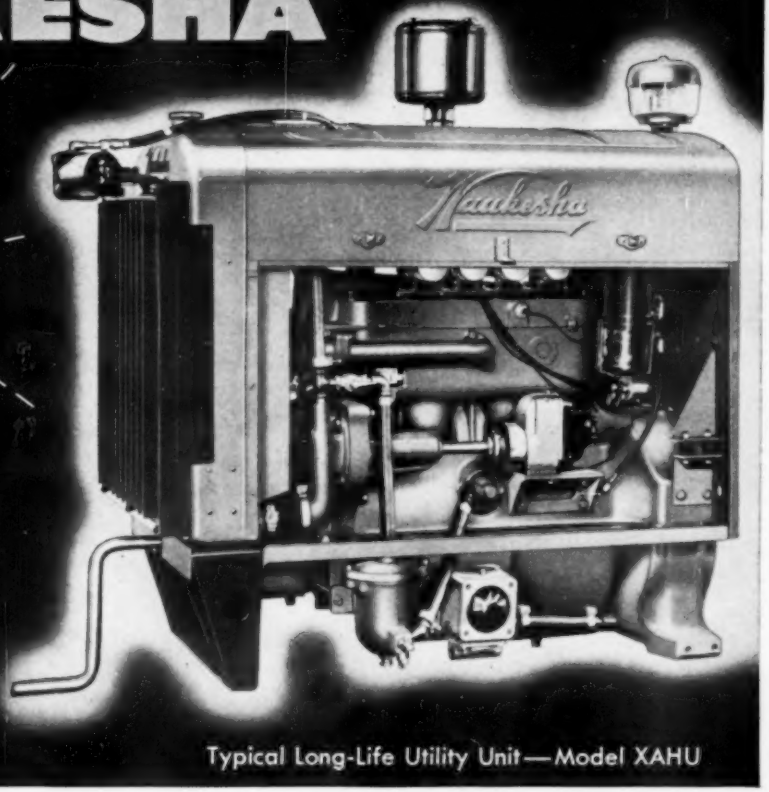
THE COLORADO FUEL AND IRON CORPORATION
DENVER, COLORADO

4924

WAUKESHA

LONG LIFE

OIL FIELD POWER UNITS



Typical Long-Life Utility Unit—Model XAHU

Continuous Duty Power—for long periods *without servicing*

The *Long-Life* oil field Waukeshas are special gas power units—with additional features and accessories built right in. That's why they operate without any of the usual routine maintenance and attention. Now, the inspections needed are few and far between.

Just give these *Long-Life* units a regular and uninterrupted fuel supply, and you'll make considerable savings—in pumping and compressor service for oil and gas pipe line feeder operation, and similar uses.

Basically these *Long-Life* power units have the standard gas engines—long famous for being rugged and reliable—that have made Waukesha the world's finest oil field power.

On these basic engines Waukesha assembles the many *Long-Life* design-specials including specially lubricated clutches; automatic oil levelizers; low tension magnetos, with individual coil, low wear spark plugs; special fan belts, and water stabilizing filters; water condensers, and automatic radiator shutters. You'll want details on all *Long-Life* features.

Send for descriptive bulletin 1702.

LONG-LIFE CONTINUOUS DUTY NATURAL GAS UNITS					RECOMMENDED 65% HP RATINGS				
Model	Features*	Bore & Stroke	Displ.	Speed (rpm) →	800	1000	1200	1400	1500
FCU	4-Ir	3¼ x 4	133		7	9	11	13	14
XAHU	4-Ir	3⅜ x 4½	186		10	14	17	20	21
190-GLBU	6-A	3¾ x 4	265	CONTINUOUS DUTY ratings shown are 65% of maximum hp available at indicated speeds →	19	23	27	31	32
195-GKU	6-A	4⅛ x 4	320		20	25	31	36	38
135-GKU	6-A	4¼ x 5	426		28	34	41	47	50
140-GZU	6-A	4⅝ x 5½	554		42	52	62	71	.....
145-GZU	6-A	5⅜ x 6	817		62	77	90	103	.....
WAKU	6-A	6¼ x 6½	1197		84	114	124	.....	.....

*Features: 4, 6—No. Cylinders; A—Aluminum Pistons; Ir—Cast Iron Pistons

WAUKESHA MOTOR COMPANY

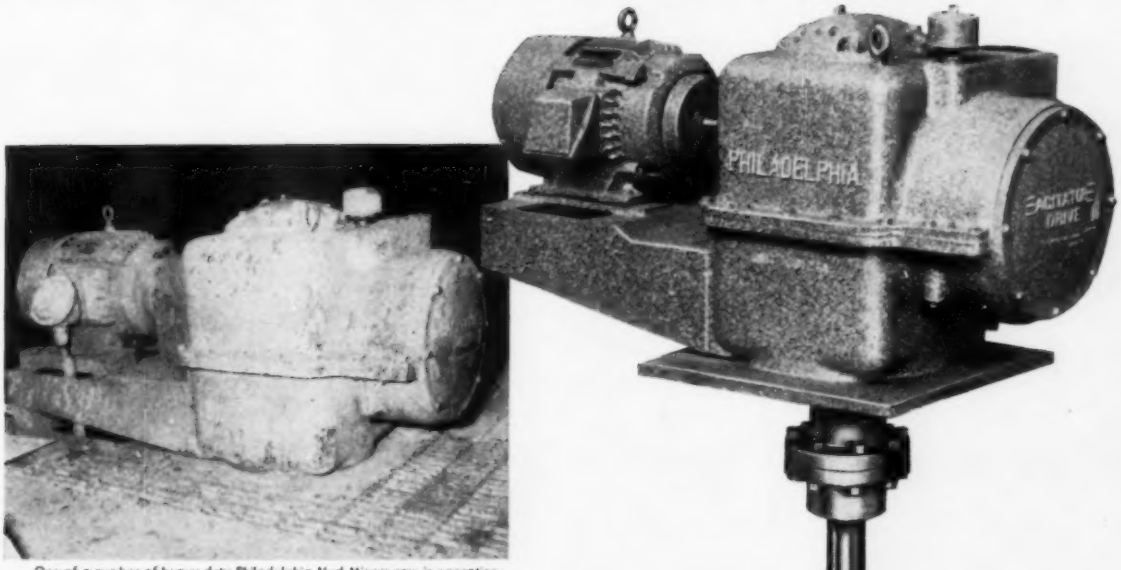
WAUKESHA, WISCONSIN

New York • Tulsa • Los Angeles

350

PHILADELPHIA MUD MIXERS...

more rugged–for more years of dependable service



One of a number of heavy duty Philadelphia Mud Mixers now in operation.

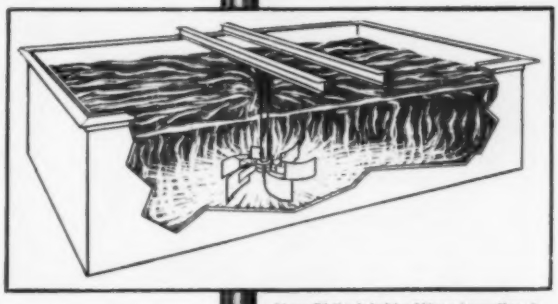
For Suspension of Drilling Mud:

The turbine type mixer has become the accepted standard wherever holes are being drilled—doing the job with less horsepower, providing large dollar savings in pump maintenance costs. Philadelphia Mud Mixers, with higher torque capacity, have provided outstanding performance in drilling mud suspension.

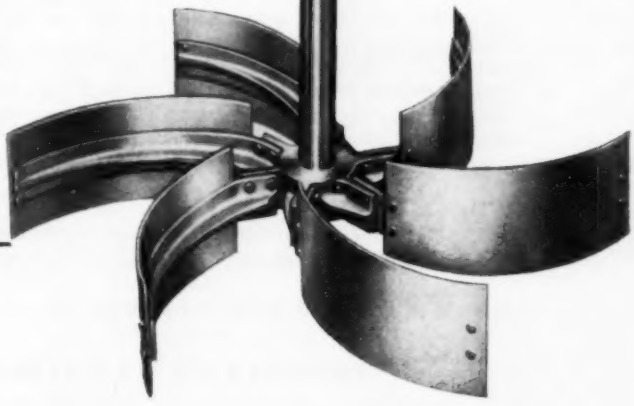
For Longest, Lowest Cost Mixer Service Under Severe Conditions:

Philadelphia Mixers and Mixer Drives have been recognized for outstanding durability for over 30 years. Each vital component in these big, rugged drives is supplied with the extra capacity that means added years of service. Every shaft in each drive is oversized to tolerate maximum shock loading encountered in severe service—then supported by big, high capacity roller bearings. Every design feature makes for more years of service, more cost savings to the user.

GET THE FULL STORY ON PHILADELPHIA MIXERS. SEND FOR CATALOG A-27 TODAY.



New Philadelphia Mixer impeller design eliminates settling out . . . keeps mud uniform . . . mixes instantly.



philadelphia mixers®

PHILADELPHIA GEAR WORKS, INC.

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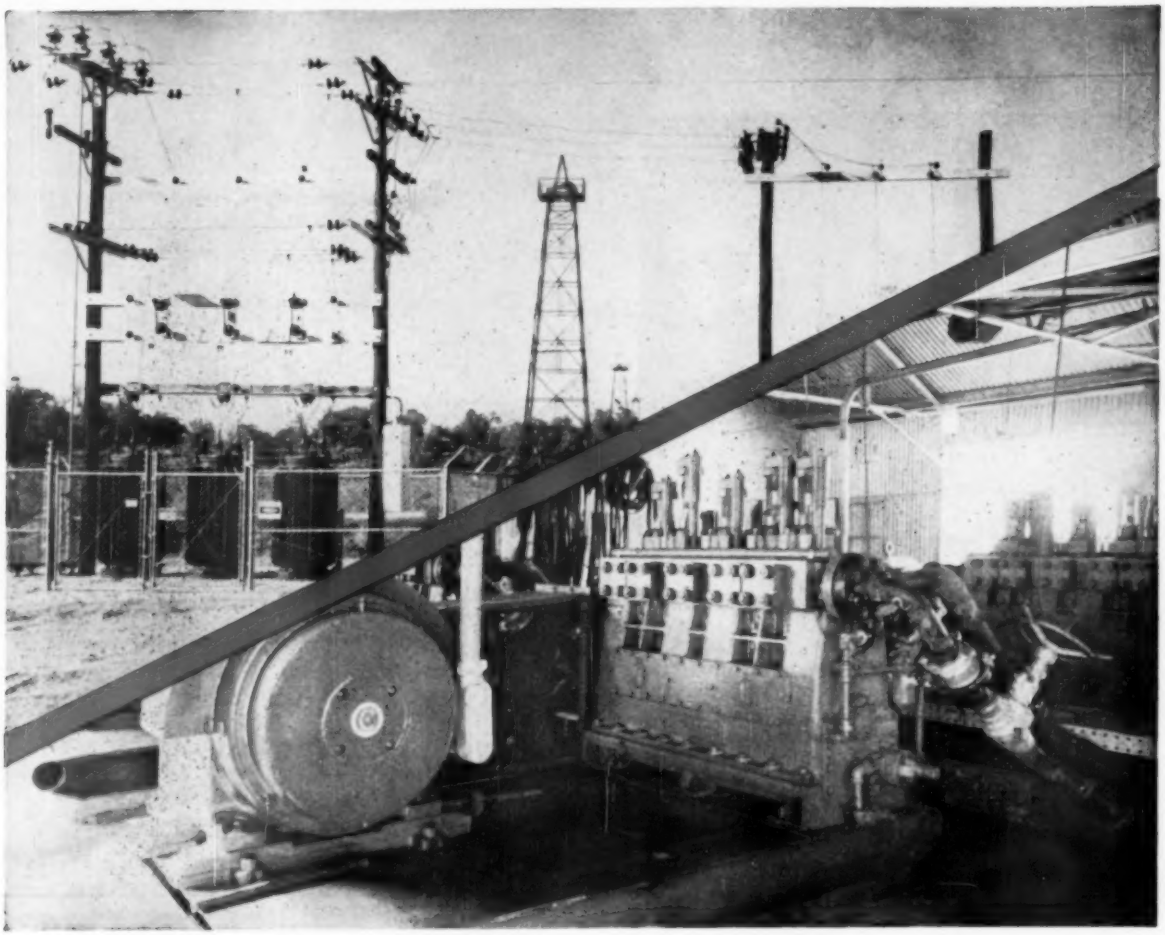
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS
LIMITORQUE VALVE CONTROLS
FLUID MIXERS • FLEXIBLE COUPLINGS

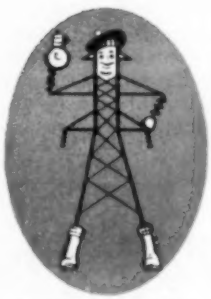
Virginia Gear & Machine Corp. • Lynchburg, Va.

WATER FLOODING OPERATIONS ARE TURNING MORE AND MORE TO UTILITY ELECTRIC POWER



Progressive Management Finds the Solution

Are you doing water flooding? Do you have plans to do water flooding? If so, don't settle on the power equipment until you have carefully investigated what UTILITY ELECTRIC POWER can do for you. The sales engineer of your Utility Electric Power Company has many actual case records which demonstrate that it is more efficient . . . more economical to use Electric Power. Be modern . . . be progressive . . . enjoy all the benefits of truly automatic, push-button power – Use UTILITY ELECTRIC POWER.

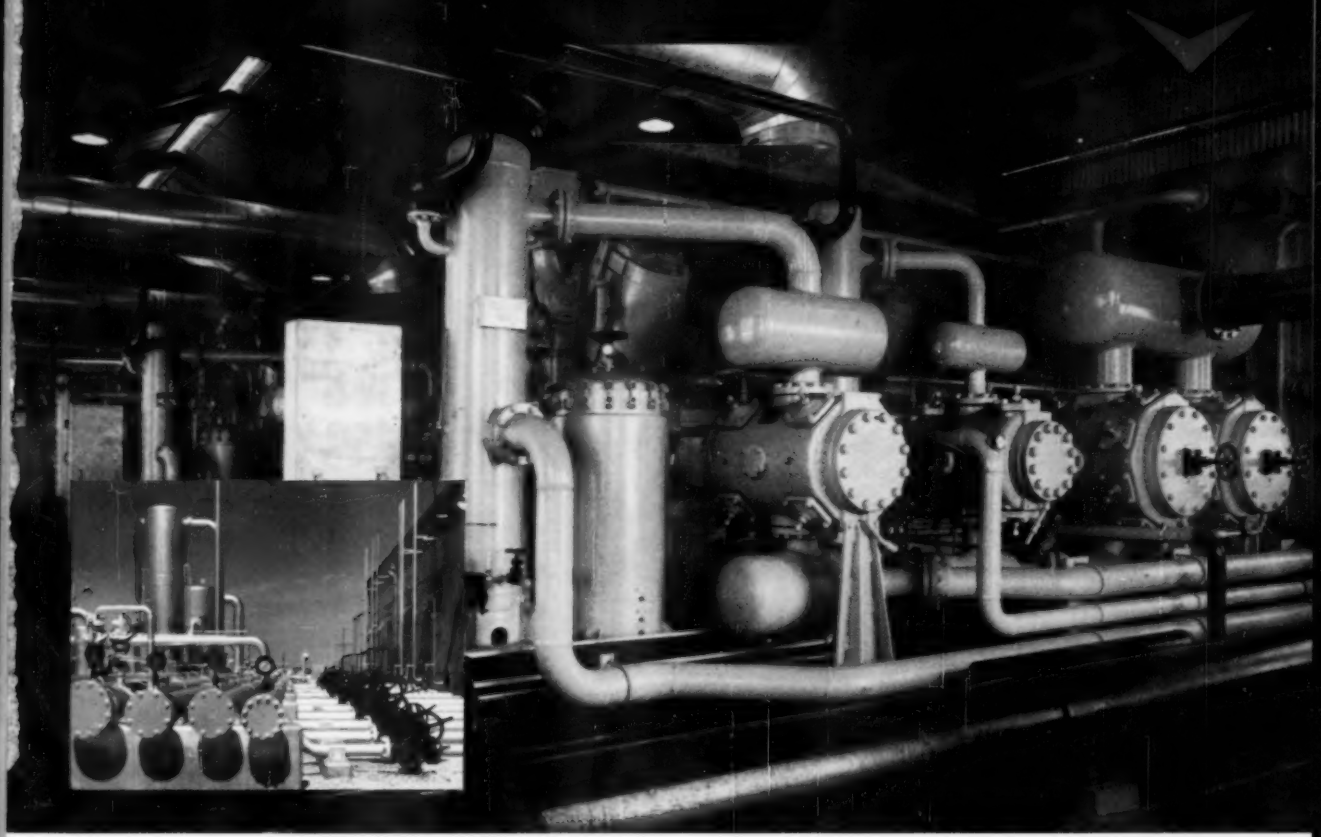


I'm LCP – Low-Cost Power on the Job 24 Hours Daily

PETROLEUM ELECTRIC POWER ASSOCIATION

P. O. BOX 35006, DALLAS, TEXAS

BEAIRD-INGERSOLL-RAND Packaged Compressor Plant



REEF FIELDS GASOLINE CORPORATION'S Good Field Compressor Station—equipped with five Beaird-Ingersoll-Rand 660 h.p. 12SVG packaged compressors . . . Young radiators and all necessary controls. Other sizes 120 to 660 h.p.

Boost Gas . . .

PACKAGED COMPRESSORS HANDLE 278 SPRAYBERRY WELLS

Reef Fields Gasoline Corporation built the Good Field Compressor station to boost separator gas from low pressure wells to a natural gasoline plant sixteen miles away. Originally planned to handle Good Canyon Reef Field, the station has now been expanded to gather gas from the Jo-Mill Sprayberry Field. Five Beaird-Ingersoll-Rand 12SVG 660 h.p. packaged compressors have been installed to handle this increased load.

Picking up from the wells at 3 psig. the units boost the gas through three stages of compression to discharge at 600 psig. At present 278 wells are tied into the station which has a total volume of 18,000 MCF per day. Of this capacity, the five Beaird units recently added, are handling 12,000 MCF per day.

Packaged compressors were selected for the Good Field Station as total compressor requirements cannot be determined until the Sprayberry field is fully developed. Also the field is expected to have a relatively short life. As production tapers off, the units can be moved one at a time with little or no change to other service. The remaining units can be kept fully loaded in this manner until the field is depleted.

Let us give you all the facts about the economy of installing multiple Beaird-Ingersoll-Rand packaged compressor plants.

BEAIRD
another AMF product
PACKAGED COMPRESSOR PLANTS

LOWEST COST PER HORSEPOWER INSTALLED

THE J. B. BEAIRD COMPANY, INC.
Shreveport, Louisiana
A subsidiary of American Machine & Foundry Company

SHREVEPORT, LOUISIANA • *Sales Offices: Dallas, Houston, Corpus Christi and Midland, Texas • New Orleans, Louisiana • Tulsa, Oklahoma • Denver, Colorado Los Angeles, California • Caracas, Venezuela, and Cie. Ingersoll-Rand, Paris, France.*

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Stocked in the Mid-Continent Area by
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PROMPT SERVICE!

HOMCO'S reputation is built on it!

The ever increasing demands of the petroleum industry require promptness and alertness.

Supply stores must be located near the base of operations, stocks must be adequate and service **must** be the motto.

HOMCO is a part of the American Competitive System offering its facilities, day or night, anywhere, anytime. When you think of supplies, think of HOMCO.

OILFIELD SUPPLY AND SERVICE ORGANIZATION · THE WORLD'S LARGEST INDEPENDENT · DIRECTIONAL DRILLING · FISHING AND CUTTING · OILFIELD SUPPLIES · ELECTRICAL WELL SERVICE

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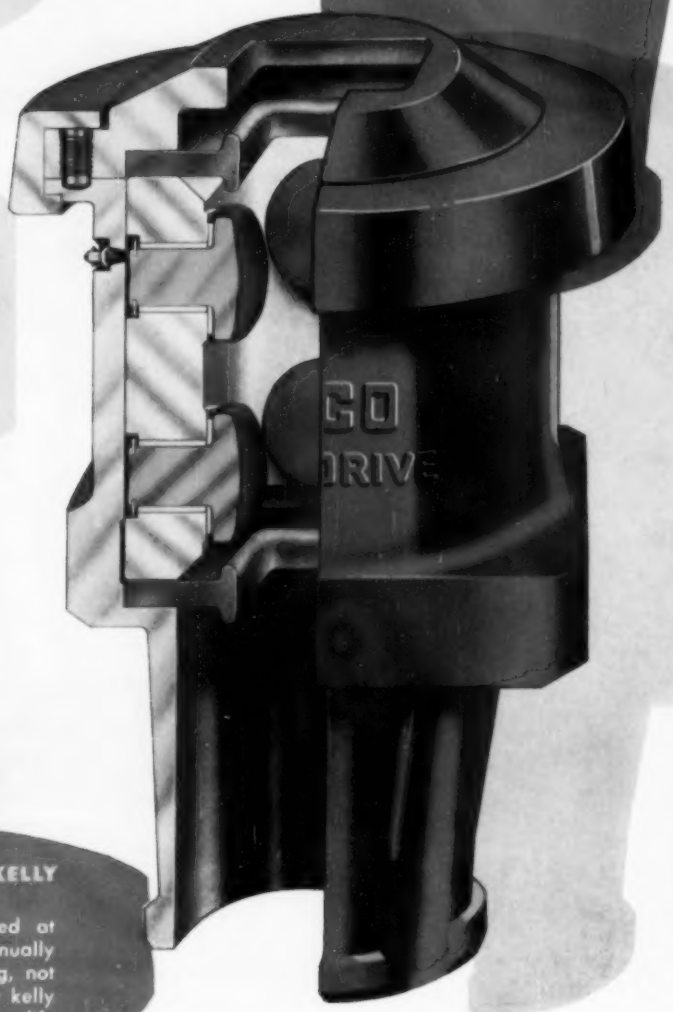
How fast is your present kelly drive wearing out your kelly?

WHY NOT GET *ALL* THE KELLY LIFE YOU *PAID* FOR WITH THE

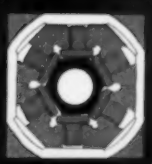
Revolutionary IDECO *Rolling Disc Kelly Drive*



HERE'S HOW IT SAVES YOUR KELLY

Revolutionary crowned discs, mounted at slight angle to flat face of kelly, continually rotate as kelly moves past, smoothing, not gouging or grooving as with ordinary kelly drives. Broad driving surface prolongs life of discs as well as kelly. Clearances adjustable by adding shims. Easy servicing on rig floor without special tools.

FOR SQUARE KELLYS


FOR HEXAGONAL KELLYS

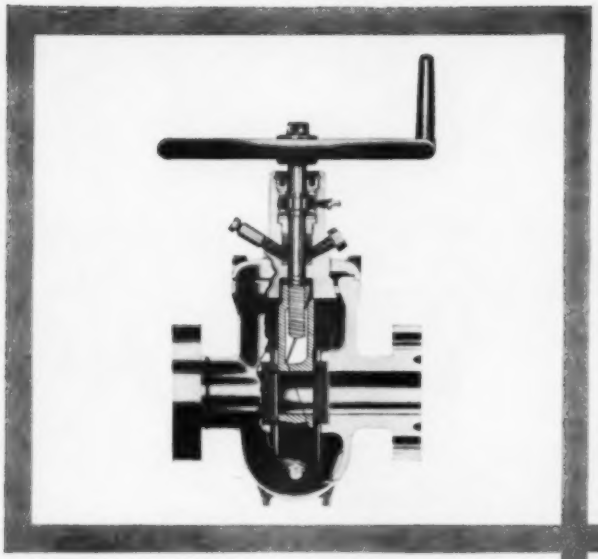
- **FLEXIBILITY:** Use same body whether you are changing sizes or types kellys, square or hexagonal, or modernizing existing Ideco Roller Kelly Drive.
- **ECONOMY:** More than a year of rugged field service and world-wide acceptance proves you get longer life for both kelly drive and the kelly itself.
- **PROVED DESIGN:** Original outstanding advantages of earlier models have been retained, such as integral pilot tube, 100% grease-packed lubrication.

When only the best will do ...use

IDECO

ONE OF THE DRESSER INDUSTRIES

POST OFFICE BOX 1331 • DALLAS 21, TEXAS



new!

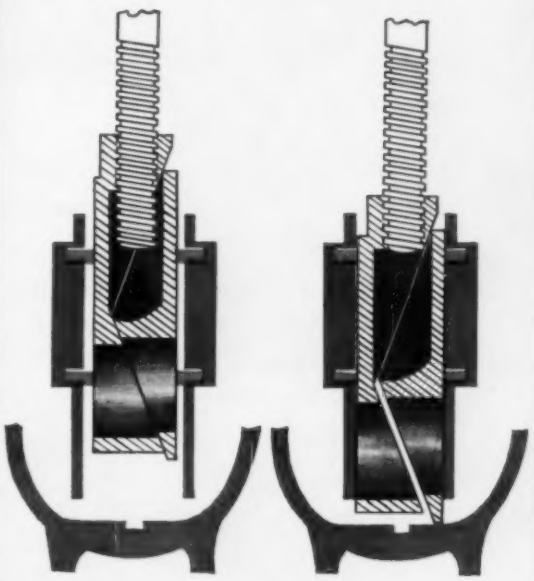
EXCLUSIVE DOUBLE-TIGHT SEAL**

Gives W-K-M Valves Unequaled Sealing Ability

W-K-M's Exclusive DOUBLE-TIGHT SEAL literally doubles the sealing efficiency of W-K-M® * Valves. A specially designed Teflon† seat insert is the secret of the DOUBLE-TIGHT SEAL. The first seal occurs when the expanding gate and segment faces contact the Teflon insert. The second seal is made by intimate contact of gate and segment faces and metal seat. Together, the Teflon and metal seal ring provide the DOUBLE-TIGHT SEAL which holds the heaviest viscous fluids—the lightest gases at pressures up to 5000 psi. The DOUBLE-TIGHT SEAL is applied both upstream and downstream.

The self-lubricating Teflon insert provides a smooth, slick surface for the gate and segment to glide across. It compresses when the gate and segment expand in the open or closed position. The Teflon insert will not flow—it is immune to acids, alkalis and all petroleum fractions. It will not vulcanize—and never requires lubrication.

DOUBLE-TIGHT SEAL is another in the long list of advantages which mean better performance, longer service, lower upkeep with W-K-M through-conduit gate valves. Teflon inserts are standard on all oil field valves through 4" up to 5000 psi w.p. and are available for larger size valves. Seats with Teflon inserts can be put in W-K-M Valves now in service.



INTERMEDIATE POSITION: Exaggerated view showing gate collapsed during opening and closing. Notice the Teflon seal retains contact with gate and segment. Foreign matter cannot fall into valve body.

CLOSED POSITION: Metal-to-metal forced seal with Teflon compressed into seat by parallel expansion of gate and segment. The Teflon wipes the metal surfaces clean for perfect seal.

**PAT. PEND. †DU PONT'S TETRAFLUOROETHYLENE RESIN. © 1957, ACF INDUSTRIES, INCORPORATED. *TRADEMARK OF ACF INDUSTRIES, INCORPORATED.

W-K-M

DIVISION OF ACF INDUSTRIES INCORPORATED

PLANT: MISSOURI CITY, TEXAS
MAILING ADDRESS: P. O. BOX 2117, HOUSTON, TEXAS

Write Dept. A-1014 for your copy of W-K-M Catalog 200 which covers the complete line of W-K-M Through-Conduit Gate Valves for Oil Field Services.

MANUFACTURERS OF W-K-M GATE VALVES · ACF LUBRICATED PLUG VALVES · KEY-KAST ALLOY STEEL PIPING FITTINGS · KEY RETURN BENDS AND FITTINGS

5717

No. 4 advertisement of six proving . . .

why Jones sucker rods last longer

1. *Advanced Research and Development*
2. *Advanced Engineering Experimentation and Control*
3. *Advanced Metallurgy and Heat Treating*
4. ✓ *Advanced Manufacturing and Production*
5. *Advanced Inspection and Testing Techniques*
6. *Advanced Field Engineering and Service*

There is a

The S. M. Jones Company

ADVANCED MANUFACTURING and PRODUCTION METHODS

Each Jones Sucker Rod is precision forged after heating in high-speed furnaces. Heat treatment is carefully controlled, after which bars are descaled and shot peened to increase fatigue resistance.

Threading is done on automatic machines to close limits and A.P.I. standards. Threads are inspected with gauges which are periodically checked against A.P.I. master gauges.

A synthetic baked enamel finish is applied to protect the rods in shipment and storage.

Each coupling is accurately tapped straight through the bore and A.P.I. gauged to assure perfect make-up between coupling and rod. Coupling faces are ground while the coupling is rotating on an A.P.I. threaded arbor. Faces are always ground at right angles to the thread axis. This fine thread and ground face provide joint make-up that will assure linkage stronger than the rod.

JONES QUALITY SUCKER RODS
SINCE 1891

The S. M. Jones Company modern manufacturing plant, Toledo, Ohio

THE S. M. JONES COMPANY

●

Division of Buffalo-Eclipse Corporation

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difference in sucker rods

JONES

alloy

SUCKER RODS

TYPE 12

For added strength to lift heavier loads with no increase in rod size.

Made from strong, corrosion resistant nickel chromium molybdenum processed electric furnace steel, fully normalized and drawn; has exceptionally high yield strength and excellent fatigue resistance.

SPECIFY—Jones Sucker Rods for deep wells and all wells . . . for proved longer life.

FOUR TYPES OF JONES SUCKER RODS FROM WHICH TO CHOOSE

Type	Identification	USE	DESCRIPTION	PHYSICAL PROPERTIES					
				Yield 1000 psi	Ultimate 1000 psi	% Elong. in 8"	% Red. of Area	Izod	Brinell Hardness
J-12	Protector ends painted BLUE	For heavy pumping loads under all conditions	Made from processed electric furnace steel with high yield strength and excellent fatigue resistance.	95-105	110-125	12-17	65-75	90-110	229-260
J-8	Protector ends painted BLACK	For extremely heavy pumping loads	A special alloy steel of exceptional yield strength and well-balanced physical properties.	100-115	120-135	10-15	50-60	65-85	240-280
J-7	Protector ends painted ORANGE	For medium to heavy pumping loads under all conditions	Called "standard of the industry". Strong, corrosion resistant nickle molybdenum steel, fully normalized, tempered, descaled and shot peened for further fatigue and corrosion resistance.	85-90	95-100	14-22	60-70	90-107	170-210
J-2	Protector ends painted WHITE	For medium to heavy pumping loads in non-corrosive fluids	High grade carbon manganese steel, fully normalized, descaled and shot peened to add strength and endurance.	60-75	90-105	18-24	60-70	60-90	160-210

Jones Pony Rods carry the same physicals as Jones Sucker Rods. Always use proved superior Jones Pony Rods with proved superior Jones Sucker Rods.

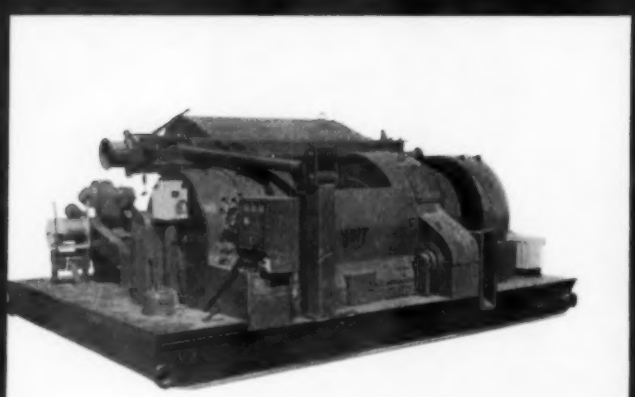
PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION

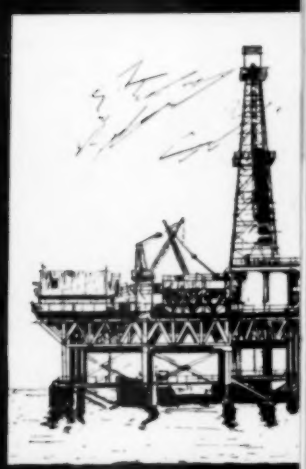
6174

the U-1220-EB *electra-flow* draw works

for greatest economy and smoothest performance...anywhere!

featuring 2 1/2" pitch triple extra heavy drum drive chain and single or split package





UNIT RIG & EQUIPMENT CO.
TULSA, OKLAHOMA U.S.A.

UNIT RIG & EQUIPMENT CO.

Export Sales: MID-CONTINENT SUPPLY CO.
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Box 1889, Tulsa, Okla.

Unit Rig's Electra-Flow draw works — model U-1220-EB — in a single or split package — now offers the operator the widest application of the operating advantages of electric power for land or offshore drilling. Electric motors with rated horsepower of 1200 to 2000 are mounted as an integral part of the compact design. Dual input drive, coupled with high and low drum drives, provide four hoisting speeds. These speeds, coupled with the wide range of power and control of D.C. electric motors, give ideal performance characteristics. Two forward and two reverse speeds are available to the rotary, catshaft and optional sand line drum.

For maximum flexibility, greater operating economy, and trouble-free performance, ask your nearest Unit Rig representative about the U-1220-EB Electra-Flow draw works. Or write Unit Rig in Tulsa for new catalog.

They Say—

Error puts coal tar on base

Dear Sir:

Your article, "New Line Steps Up California Gas Supply," (OGJ, Sept. 16, 1957, p. 137), is very interesting and informative.

Knowing that asphalt pipe coating was used on this line, we were taken aback to note your crediting coal tar—our arch enemy, of course—with the honors. You can check this with the Fulton people (R. H. Fulton & Co., pipeline contractors).

We take it to be fair to shame our oil industry for using coal tar on many of their pipeline coating jobs rather than the equally efficient, well recognized, and assuredly cheaper, asphalt-base coating supplied by many of our refiners. It is a sad commentary that on the projected Four Corners line, one section only is to use asphalt coatings. This must make the coal-tar folks very happy.

A. M. Lockhart
Envoy Petroleum Co.
Long Beach, Calif.

Buy American act ignored

"The law (Buy American Act) provides that the federal Government when making purchases for public use give preference to domestic products if the products are produced 'in the United States in sufficient and reasonably available commercial quantities and of satisfactory quality.'

"Recently the Military Petroleum Supply Agency announced awards for jet fuel. Of this award, about 8,000,000 bbl. went to Caribbean refineries.

"This purchase is contrary to the intent and purpose of the Buy American Act. . . ."

Russell B. Brown, general counsel, Independent Petroleum Association of America, in a letter to members of I.P.A.A.

No "suicidal remedy," please

"Inflation presents a double threat to our national welfare: First there is the danger of the disease itself; and second, there is the still-greater danger that — failing to understand the problem thoroughly—we may be led to resort to some suicidal remedy.

"I am disturbed by the fact that

WILLIAMS
LOCKING ADJUSTABLE WRENCHES

WITH THE
HEAVIER . . .
MORE RUGGED
"PUSH BUTTON"
LOCKING DEVICE

Featuring exclusive advances in an outstanding design—Williams new improved, patented Locking Adjustable is built to resist the abuse of heavy service commonly associated with this type of wrench. Diagrams point up major improvements in locking mechanism.

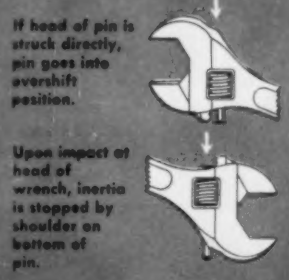
Available in 6, 8, 10, 12 and 15" sizes, Williams Locking Adjustables offer rapid, one-hand adjustment and positive protected locking in precision drop-forged construction.

Your local Williams distributor will give you fastest service at lowest cost.

For detailed data on the "Broadest Line of its Kind" . . . WRITE for Catalog 303.

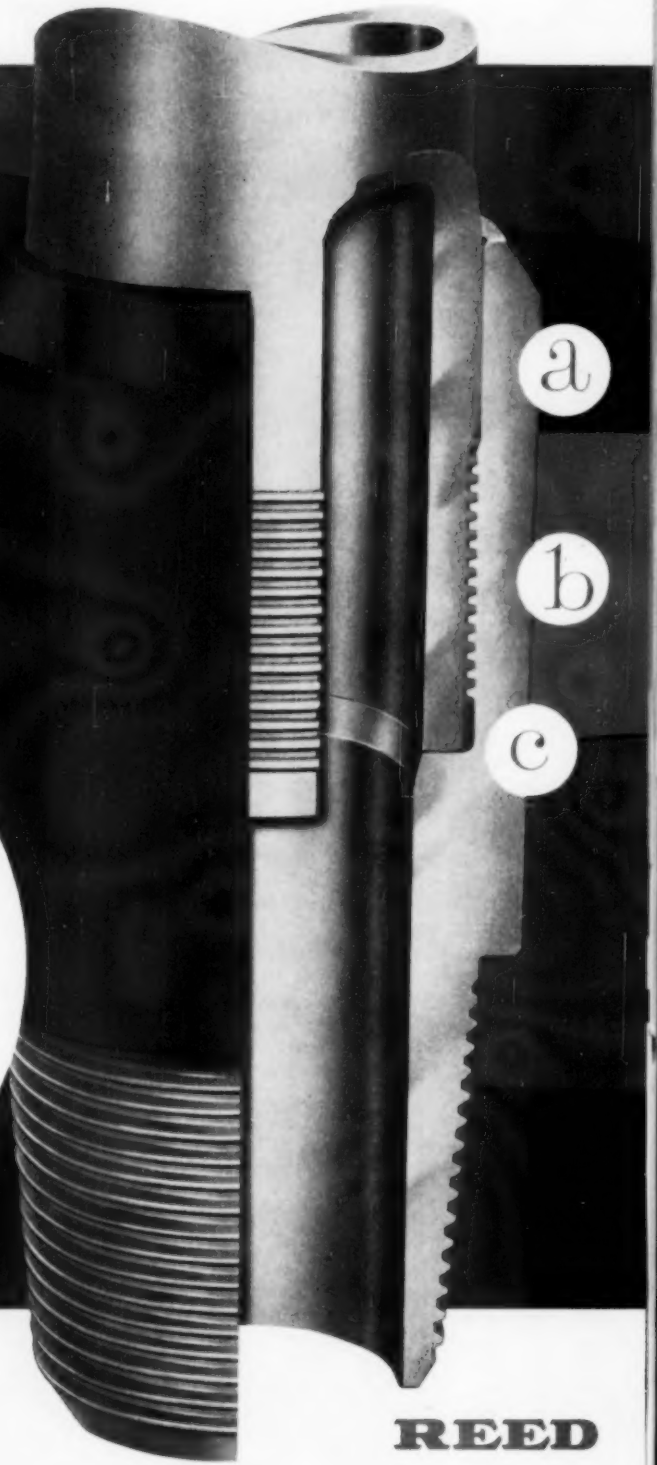
DUE TO WILLIAMS CONTINUOUS PRODUCT DEVELOPMENT PROGRAM THESE 4 IMPROVEMENTS HAVE BEEN MADE

2-way protection of locking mechanism


If head of pin is struck directly, pin goes into overshift position.
Upon impact of head of wrench, inertia is stopped by shoulder on bottom of pin.

J. H. WILLIAMS & CO.
412 VULCAN STREET, BUFFALO, N. Y.
BUFFALO • NEW YORK • CHICAGO • LOS ANGELES

REED FIELD-PROVEN TOOL JOINTS



REED

Super Shrink-Grip

SSG-R TOOL JOINT

FOR LIGHT WEIGHT DRILL PIPE

a — The shrink-grip "safety area" supports the drill pipe beyond the last engaged thread . . . and seals against leakage.

b — Entire thread length protected by a seal at each end.

c — New SSG-R design assures maximum pipe end thickness maintained to give greatest area to shoulder seal. (Exclusive Reed feature.)

REED

FOR LIGHT WEIGHT DRILL PIPE

If your operation requires light weight drill pipe, look to the leader for the right tool joint

REED has been the pioneer in designing and developing tool joints for use on light weight drill pipe. In fact, Reed has supplied most of the tool joints for light weight drill pipe now in use.

Reed has developed and field-proved special design light weight tool joints. In addition, Reed tool joints for light weight drill pipe can be furnished with API-thread working connections. These tool joints can be manufactured with the same O.D. dimensions, box and pin length, tong space, and hard facing if desired, as Reed tool joints for conventional drill pipe. You may order Reed tool joints specifically designed for use with light weight drill pipe in both Super Shrink-Grip and Flash Welded types.

A special feature of Reed's Super Shrink-Grip tool joint permits a thicker pipe end for the shoulder seal (see illustration). This exclusive Reed design assures a perfect shoulder seal, even though there may be some eccentricity in the thinner light weight drill pipe end.

Reed alone offers a tool joint that's right for every drilling need. If you want more facts about tool joints for *light weight* drill pipe, ask the leader . . . ask the Reed Man!

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STANDARD AND OPTIONAL EQUIPMENT

On Leading Diesel Trucks, Tractors & Stationary Engines

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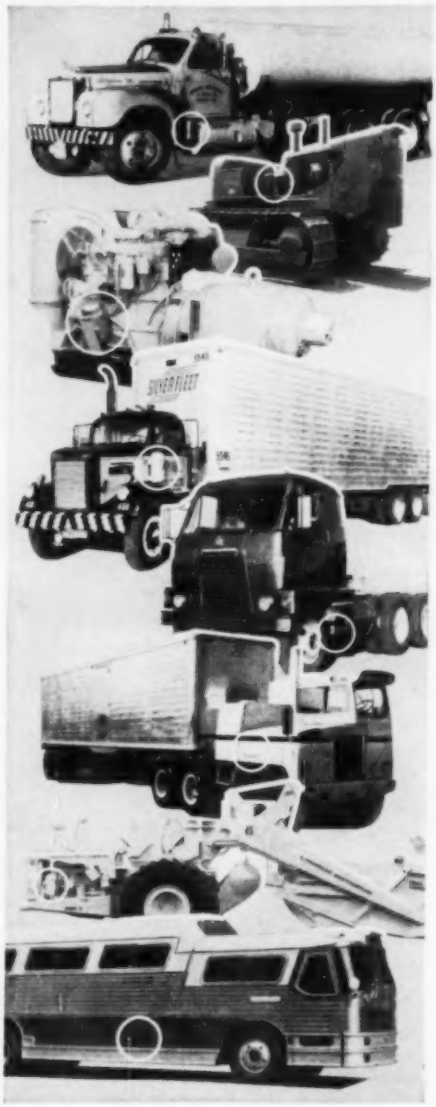
POWERFUL PROOF OF LUBER-FINER'S UNSURPASSED EFFICIENCY

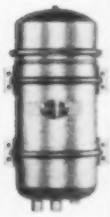
Only Luber-finer Filters produce the patented filtering process that gives engineered protection to engine and oil as recommended by equipment manufacturers. The vital oil supply is circulated through Luber-finer's exclusive specially processed media which removes not only the injurious suspended solids from the oil but also the colloidal impurities which are often more damaging, thus increasing the life of both engine and oil.



THE EFFICIENCY OF LUBER-FINER'S PATENTED PROCESS HAS NEVER BEEN EQUALLED!

Luber-finer's patented filtering process adds thousands of miles to engine and oil life by cleaning oil faster and keeping it clean longer. Luber-finer gives more service and engineered protection than any other filter unit.

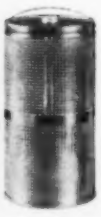
FOR EVERY TYPE OF ENGINE ...EVERY TYPE OF OIL



INSIST ON GENUINE LUBER-FINER PACKS FOR EXCLUSIVE ENGINEERED PROTECTION

DIESELPAK — Designed expressly for use with H. D. detergent compounded oils. The Dieselpak is unequalled in efficiency in removing impurities and contaminants without affecting the additives. (May also be used with fuel oil and straight mineral oil if desired).

REFINING PACK — Designed for use with straight mineral oils, fuel oils, hydraulic oils and inhibited industrial oils. The Refining Pack, combines ABsorbent with ADsorbent filtration, removes acids, moisture, suspended particles and colloidal impurities during its effective life more efficiently than any other filter and has been the standard of the industry since 1936.



Write for complete information Dept. 8

LUBER-FINER, INC. 2514 S. Grand Ave., Los Angeles 7, Calif.

many of our influential leaders seem to be more interested in finding a scapegoat upon which to vent our national wrath than in locating the real cause, and effectuating the cure of the malady . . .

"An uninterrupted rise in the cost of living—if it continues long enough—will provide a powerful weapon in the hands of those who have never abandoned their efforts to atomize business, destroy our system of competitive capitalism, and to refashion our national economy in the image of the foreign ideological gods at whose shrines they seem to worship.

"Yet the fact is, of course, that the present inflation is by no means unique to America. It is world wide. And thus far, it has been much less severe in the United States, under freedom of enterprise, than it has been in many of the nations abroad where government exercises wide socialistic powers.

"The current annual report of the Bank for International Settlements presents a study showing the rise in the cost of living in 13 of the other principal nations in the world during the past 3 years; and in 12 of these countries prices have gone up much farther than in the United States. Only in Japan have they risen less.

"So it would appear that the methods which are now being employed, under our free enterprise system, to combat inflation have been more effective than those which are in general use abroad."

Roger M. Blough, chairman of the board, United States Steel Corp., in a speech to the American Bankers Association.

Tidewater asks quota change

"The inequity in Tidewater's assigned (imports) quota is quite obvious, particularly since under such quota: (1) The new Delaware refinery, which was designed to operate most efficiently with a high percentage of low-gravity, high-sulfur, and sour crudes, would be denied the right to use adequate quantities of such materials. (2) Tidewater would be denied access to assured supplies of such crudes which are available from the foreign production of its parent company (Getty Oil Co.). (3) No consideration has been given to Tidewater for not importing residual fuel oil made from foreign crude oil processed outside the United States . . .

"Tidewater has been assigned almost one-fourth of the proposed total industry reduction in crude oil imports under the quota program . . . Tanker transportation losses under this program may be substantial because of the cur-

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LEE C. MOORE design engineers maintain constant study and research to provide a world-wide drilling industry with structures best suited to specific requirements.

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with CABOT

ADJUSTABLE CRANK BALANCED

Cabot adjustable crank pumping units are available in sizes from 7,000 to 32,000 pounds maximum polished rod load. Adjustments are simple. One man can make them from the ground. No heavy lifting. No complicated tools needed. All that's required is to loosen two bolts, move weights to desired position and tighten bolts. Single-piece inner weights easily added.

BEAM BALANCED

Cabot beam balanced pumping units are available in sizes from 3,000 to 11,000 pounds maximum polished rod load. Full beam counterweighting furnished. Weights can be easily installed any place along the beam without moving other weights. Safety rails provided. 15% crank counter weighting optional. Easily installed with two bolts.

MINIMUM OF DOWN TIME

Rugged dependability and "on the spot field service" provide a pumping unit assuring you of less down time. Cabot's 24-hour parts and maintenance shops at Odessa, Houston, Alice, Kilgore, Pampa, Compton, Great Bend, Lindsay, Seminole, Tulsa, Casper, Farmington, and Edmonton.

OIL FIELD PUMPING EQUIPMENT

CABOT SHOPS

PAMPA, TEXAS

FRANKS DIVISION OF CABOT

There's a quality Cabot pumping unit to meet your needs. Call your J&L Supply Man.

rently depressed tanker market, particularly for those companies which, like Tidewater, have incurred firm foreign-flag tanker obligations. Since it has been assigned about one-fourth of the proposed reduction in imports, and since it already has firm tanker commitments covering its import program, Tidewater would bear the largest share of tanker losses, although it is not the largest East Coast importer of foreign crude oil and does not import any residual oil.

"Tidewater's management believes that the Government, in establishing its voluntary quota system on the basis of national security needs, did not intend to discriminate against any company; but the quota assigned to Tidewater is clearly discriminatory. Tidewater considers that the quota . . . places its East Coast operations in serious jeopardy. It is, therefore, petitioning the Government for relief from the obviously untenable competitive position in which these operations would be placed by the import quota proposed for the company."

From Tidewater Oil Co.'s request for adjustment of its East Coast import quota submitted to M. V. Carson, Jr., administrator of the voluntary program by D. T. Staples, Tidewater president.

How many rascals in oil?

"When a man walks into his corporation's plant, laboratory, or office building, he is not forced to check the Golden Rule at the door. In fact, if his conduct is contrary to that rule, he is much more likely to be barred at the entrance.

"There is a good reason for this. People in business follow personal moral codes, just like anyone else. While candidates for sainthood are not in generous supply in the business community, the proportion of rascals is no greater than found among other groups of people."

Benjamin F. Fairless, president, American Iron and Steel Institute, and a director and member of executive committee, United States Steel Corp., in a speech to the National Petroleum Association.

Why an engineer shortage?

"It is well known that industry is guilty of misutilizing the engineer . . . The engineer shortage exists mainly because the enginers are engaged in doing daily tasks that nonengineers should do."

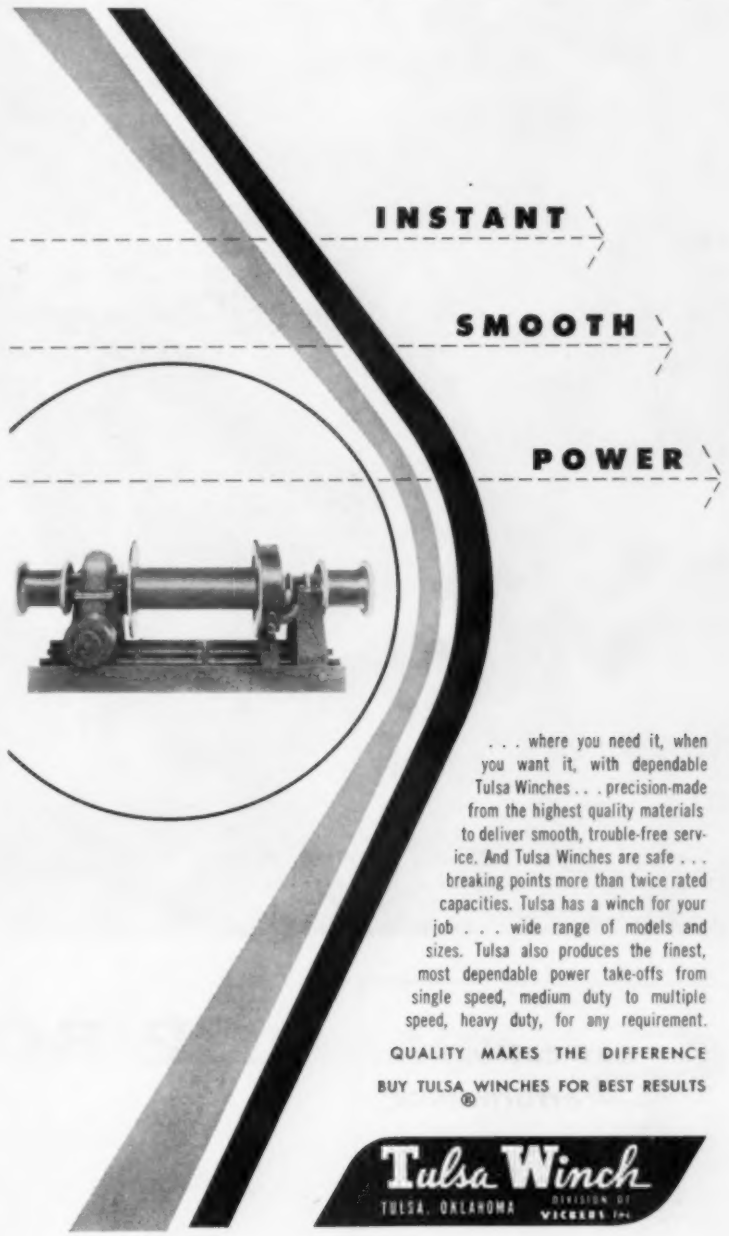
Robley Winfrey, chief of personnel and training, Bureau of Public Roads, in "How to Lick the Engineer Shortage," article in the September issue of "American Road Builder" magazine.

Allied against imports

"The independent oil men have strong allies in the persons of the governors and tax commissioners of the oil states when they seek to drop a halter on the fleet of tankers bringing petroleum from South America, the Middle East and, to an extent, elsewhere. Oil extraction produces substantial portions of the tax revenues of each of these states.

"In Oklahoma for a normal year about $28 million will come in from the gross production tax. This is one-sixth of the state's total average collections. When any of it is whittled off by additional proration, the cries from the statehouse are discernible among the vocal protests of the oil men about importations.

"In Texas, where proration has resulted in a 12-day production schedule per month, the cries are louder and carry much more pain. The Houston Chronicle reports that two-thirds of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. . . where you need it, when you want it, with dependable Tulsa Winches . . . precision-made from the highest quality materials to deliver smooth, trouble-free service. And Tulsa Winches are safe . . . breaking points more than twice rated capacities. Tulsa has a winch for your job . . . wide range of models and sizes. Tulsa also produces the finest, most dependable power take-offs from single speed, medium duty to multiple speed, heavy duty, for any requirement.
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BUY TULSA WINCHES FOR BEST RESULTS
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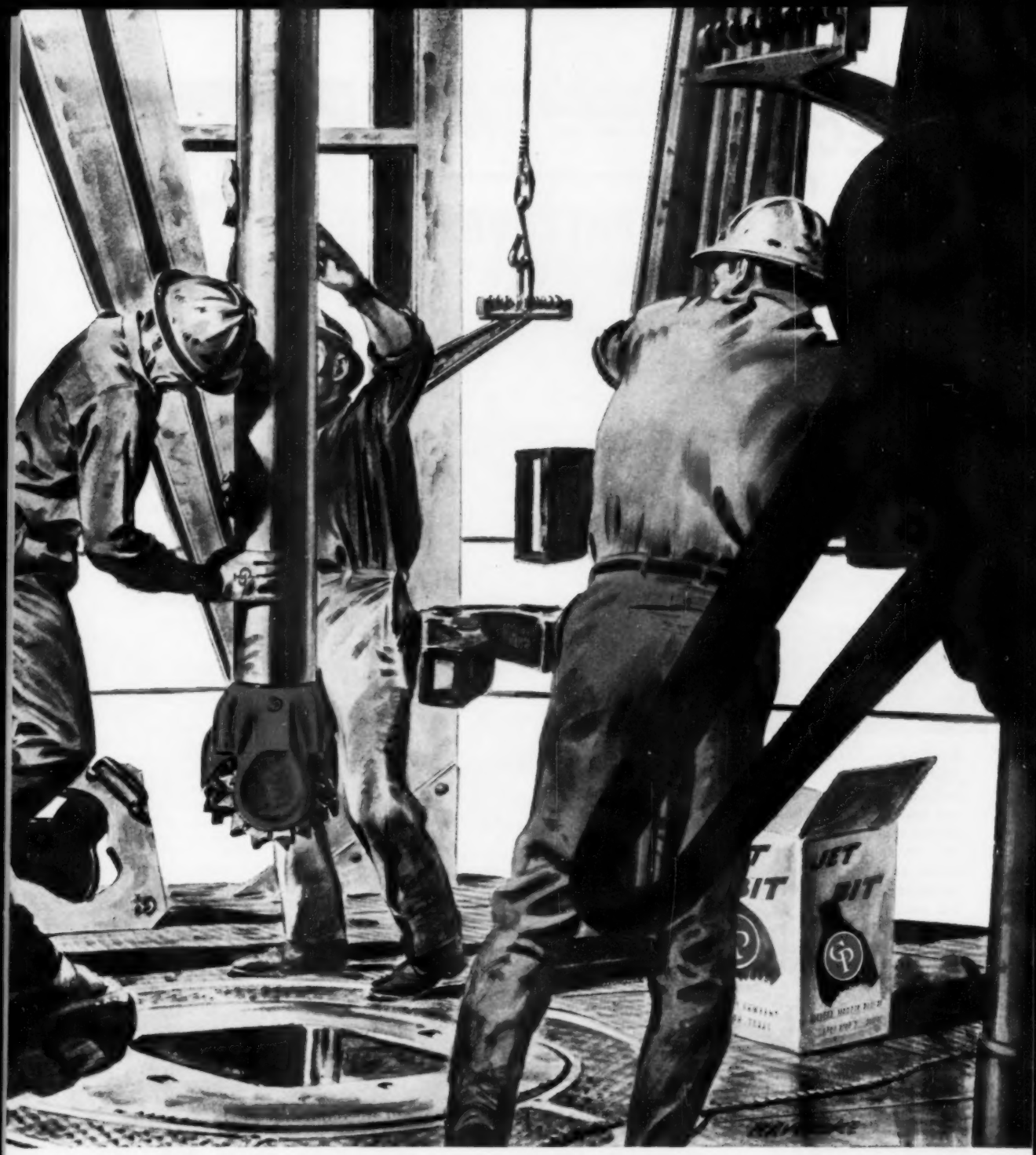

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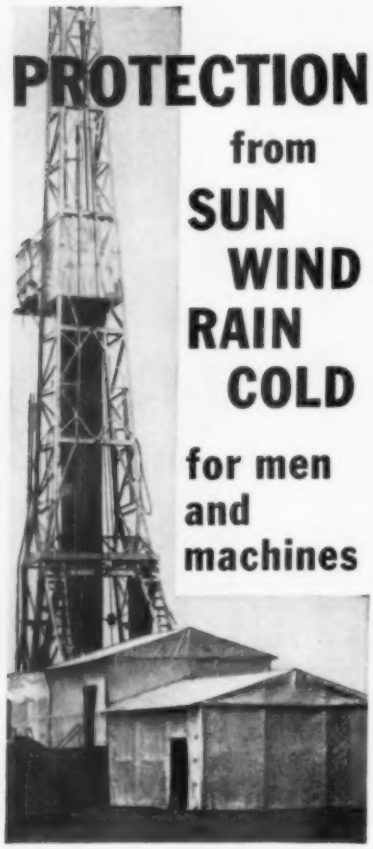

PROTECTION from SUN WIND RAIN COLD for men and machines

Easily-handled Coverlight does year 'round duty on your rigs. Its lightweight makes easy rigging up and tearing down. Mud, grime and oil stains are readily cleaned off. Coverlight is also highly resistant to aliphatics, aromatics, rot, mildew and is fire retardant. It's amazingly tough, yet when punctured, Coverlight is easily repaired on location. It's economical – provides longer life with minimum maintenance. Use Coverlight for *your* rigs. Made of tough nylon fabric with a neoprene coating, it's the *ideal* protective covering for men and machines.

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that state's tax revenues are derived from oil and gas."

Editorial in the Tulsa Tribune.

CALENDAR OF EVENTS

OCTOBER

15-16 Gas Measurement Institute, sponsored by the University of Kansas, American Legion Hall, Liberal, Kans.

16-17 South Dakota Independent Oil Men's Association, convention, Alonzo Ward Hotel, Aberdeen, S. D.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section, fall meeting, Biltmore Hotel, Los Angeles.

17-18 Abilene, Tex., Geological Society; Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, Abilene chapter; West Central Texas Oil and Gas Association; and McMurry College, second annual petroleum conference on new developments and applications in log interpretation techniques, McMurry College, Abilene, Tex.

17-19 Four Corners Geological Society second field conference, Gallup, N. M.

18 American Institute of Chemical Engineers, South Texas section, twelfth annual technical meeting, Moody Convention Center, Galveston, Tex.

20-22 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.

23-25 National Association of Corrosion Engineers, western region, seventh annual conference, U. S. Grant Hotel, San Diego, Calif.

23-25 National Association of Corrosion Engineers, seventh biennial Permian basin corrosion tour, Lincoln Hotel, Odessa, Tex.

24-25 Rocky Mountain Oil and Gas Association, midyear meeting, Northern Hotel, Billings, Mont.

24-25 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

25 Natural Gasoline Association of America, southern regional meeting, Washington-Youree and Captain Shreve Hotels, Shreveport.

25-26 Abilene, Tex., Geological Society, Fort Worth Geological Society, joint field trip, San Saba County, Texas.

25-26 West Texas Geological Society, fall field trip, Glass Mountains area, Holland Hotel, Alpine, Tex.

27-29 Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.

28-30 National Lubricating Grease Institute, twenty-fifth annual meeting, Edgewater Beach Hotel, Chicago.

31-Nov. 1 American Association of Petroleum Geologists, Mid-Continent regional meeting, Education Building, Fairgrounds, Tulsa.

NOVEMBER

3-8 Society for Nondestructive Testing.

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FIRST CHOICE

FOR SECONDARY RECOVERY WATER FLOODING . . .

because pumping with REDA lowers costs and INCREASES PROFITS!

HERE'S HOW:

- Large water volume obtained from smaller size well casings reducing number of supply wells necessary
- Flexibility of Reda Pumps in meeting changing water requirements common to most waterflooding projects
- Easier, less expensive installation and lower maintenance costs
- Low operating costs and long operating life of Reda equipment
- Corrosion resistance of Reda pumps is superior to any other pumping unit used in supply wells

Reda Submergible Pumps are a major factor in the success of waterflooding and pressure maintenance operations. They are being used in major floods with very successful results of increased production and lowered costs.

Write for complete information today! Reda engineers will be pleased to call and assist in planning operations.

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PUMP COMPANY
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With Magcobar on your well . . .

you are on your way to a better cementing job

The biggest savings a good mud program brings you come from the difficulties and unnecessary expenses which are *avoided.* These savings don't show up in the mud bill. But in total cost, yes.

If you ran casing on schedule with no sticking, no bridging, you can be sure the mud and the hole were in proper condition. You saved again if your mud had the right gel characteristics for cementing, helping to prevent channeling. And, if after perforating, you found a good cement job with no communication between zones, you have avoided an expensive squeeze job. You saved, too, if hole was close to gauge, resulting in proper cement fill-up the first time.

When the mud is planned right and prepared right for each foot of hole, the cost of drilling each foot is reduced. And when the Magcobar team is working and planning with you, you get the industry's best qualified mud engineers, the best drilling muds and chemicals—at your well when you need them. To be sure Magcobar is on your next well, start planning with Magcobar now.

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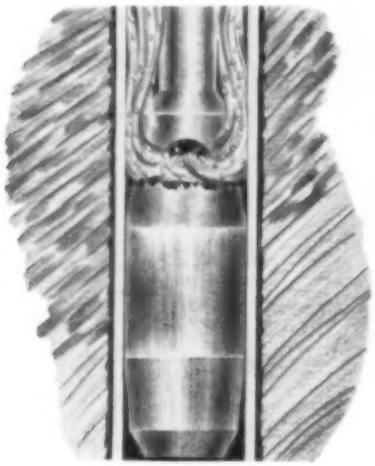

The McCullough Bridge Plug drills out easily. Average time usually runs from one to two hours. Best results have been obtained by using a regular rock bit with about one point of weight, rotating at high R.P.M. Cable tools should not be used for drilling out.

Unusual Application of McCullough Plug Shuts Off Bottom Hole Water

A production packer with 2.688" I.D. mandrel was set at 5600'. Well had been squeezed through the packer and was producing from perforations just above.

The squeeze job later failed and the well started making water through the packer mandrel. A 1¾" O.D. McCullough Bridge Plug was set in the mandrel and cement was dumped on top of the plug with a 1¾" O.D. McCullough Dump Bailer. Water shut-off was successful and the well was put back on production.

Jobs like this demonstrate the versatility of McCullough's line of Bridge Plugs. Wherever a plugging problem exists, there is a McCullough Plug to solve it.

Solid Aluminum Bridge Plug Assures Positive Seal

Set in 1951, a McCullough 4½" O.D. Bridge Plug Was Re-tested in 1956 to 5500 lbs. —Without Leakage

Seldom, in an oil well, is it possible to determine the reliability of a service performed five years previously.

This well, drilled in 1951, was cased through the pay zone with 5½" O.D. 17 lb. cemented casing. A 4½" O.D. McCullough all-metal Bridge Plug was set below the pay and the formation was squeezed for water shut-off. No cement was dumped on top of the plug. The pay zone was perforated and the well put on production.

Late in 1956 water broke into the well. The operator ran in with a squeeze tool and tested the McCullough Plug at 5500 lbs. After five years it still provided a leak-proof seal.

"runs faster"
"sets easier"
"seals securely"
"drills out quickly"

McCullough Bridge Plugs have no hardened parts—no moving parts. They are made of drillable aluminum metal. Slips, reins, rubber packers, etc. have all been eliminated. Ideal for either permanent or temporary plugging operations. Available in 37 sizes to plug in tubing, drill pipe, casing and in open hole in hard formations.

Another 4½" O.D. McCullough Bridge Plug was set just above the perforations at 8150'. Again, no cement was dumped on the plug. This zone was also squeezed with 5500 lbs. pressure. The plug was secure and leak-proof.

It required 2½ hours to run and set the plug which was drilled out three days later in 1½ hours with a rotary rock bit.

McCullough Bridge Plugs are favorites with operators and squeeze tool men. They will withstand as much hydrostatic pressure as the casing and will last as long as the casing.

The jobs described above are certified to be true field reports of services rendered.

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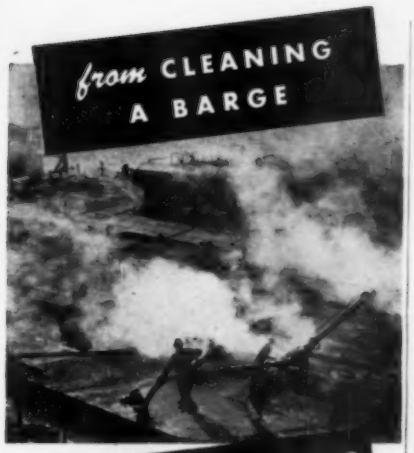

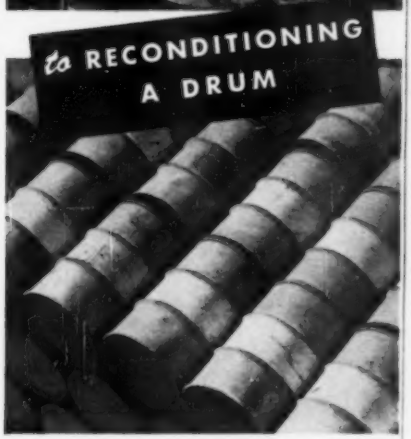

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Even tenacious, heaviest soils succumb to specialized Oakite materials. Applied by Oakite mechanized fog, steam or spray methods, they're making short work of toughest tank car or barge cleaning jobs (2 cars cleaned in 8 hours vs. 1 steamed for 48 hours!)—and with savings in material (74% for one user!)

And in just 7 minutes, one barrel house cleans, strips paint and conditions used drums good as new—good evidence that Oakite cleaning is both fast and *thorough*.

But these are just two in a wide range of cleaning jobs where you can benefit. Take a new look at your cleaning operations through the Oakite Man's eyes . . . or send for Bulletin F-7629 which tells more. Oakite Products, Inc., 39 Rector Street, New York 6, N. Y.

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Technical Service Representatives in Principal Cities of U. S. and Canada

second international conference, Hotel Morrison, Chicago.

6-8 Gulf Coast Association of Geological Societies, seventh annual convention, Roosevelt Hotel, New Orleans

6-8 Society of Automotive Engineers, national fuels and lubricants meeting Hotel Statler, Cleveland.

11-14 Society of Exploration Geophysicists, twenty-seventh annual meeting, Statler-Hilton Hotel, Dallas.

11-14 American Petroleum Institute, thirty-seventh annual meeting, Conrad Hilton Hotel and Palmer House, Chicago

12-14 National Association of Corrosion Engineers, northwest region fall meeting, Penn-Sheraton Hotel, Pittsburgh

22 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex

DECEMBER

1-3 Interstate Oil Compact Commission annual meeting, Tulsa.

1-6 American Society of Mechanical Engineers, annual meeting, Statler Hotel New York.

2-6 Twenty-sixth Exposition of Chemical Industries, Coliseum, New York.

8-11 American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.

JANUARY

16-18 Association of Oilwell Servicing Contractors, second annual convention, Baker Hotel, Dallas.

19-22 Pipe Line Contractors Association, tenth annual convention, Boca Raton Hotel and Club, Boca Raton, Fla.

31 Natural Gasoline Association of America, regional meeting, Skirvin Hotel, Oklahoma City.

FEBRUARY

16-20 American Institute of Mining, Metallurgical, and Petroleum Engineers, annual meeting, Hotel Statler, New York.

26-28 American Petroleum Institute, Division of Production, southern district meeting, Shamrock-Hilton Hotel, Houston.

28 Natural Gasoline Association of America, Permian basin regional meeting, Lincoln Hotel, Odessa, Tex.

MARCH

3-4 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fourth annual joint meeting of Rocky Mountain petroleum sections, Cosmopolitan Hotel, Denver.

5-6 Gas Conditioning conference, sponsored by the University of Oklahoma, Oklahoma Memorial Union Building, Norman, Okla.

7 Ohio Oil and Gas Association, winter meeting, Deshler Hilton Hotel, Columbus, Ohio.

12-14 American Petroleum Institute, Division of Production, southwestern district meeting, Hotel Texas, Fort Worth.

17-21 National Association of Corrosion Engineers, annual conference, civic auditorium, San Francisco.

24-26 Midwest Gas Association, Broadmoor Hotel, Colorado Springs, Colo.

31-April 2 American Petroleum Institute, Divisions of Transportation, annual pipeline conference, Jung Hotel, New Orleans.

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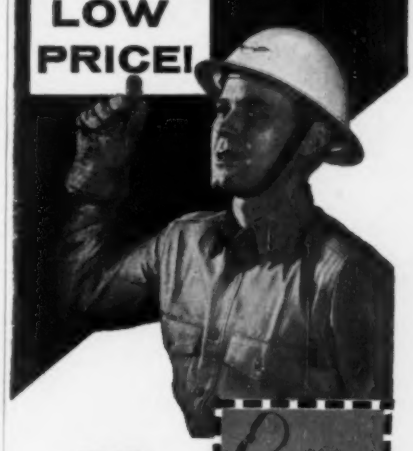

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Men *like* to wear it because it's lightweight, with wrinkle-free adjustable head band and exclusive new better-than-ever snap-in sling.

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Strong plastic construction that tops all Government safety standards, insulates against heat and sun and withstands over 10,000 volts.

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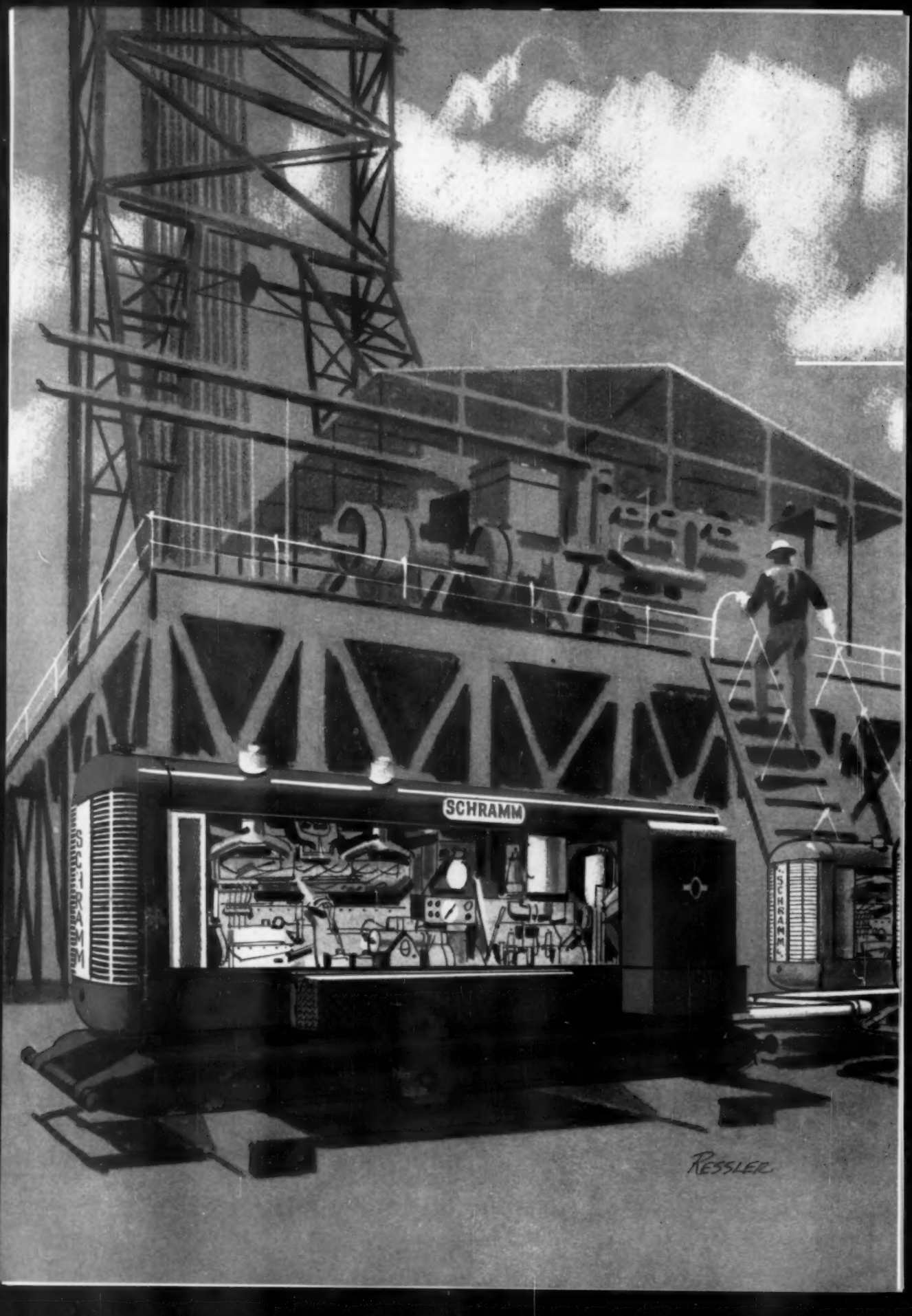
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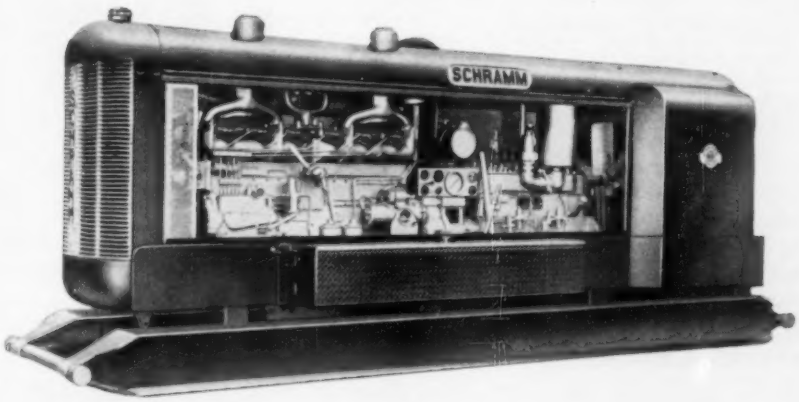
SCHRAMM
RESSLER

DRILL FASTER, CHEAPER WITH AIR



The key to more successful air drilling —the new Schramm 2-A Oilfield Booster

High pressure air has helped solve many air drilling problems. Previous attempts at air drilling often failed due to insufficient air pressure when blockages occurred. Overloading standard compressors to gain additional pressure meant breakdowns . . . excessive maintenance. However, recent experience with the Schramm 2-A Booster has proved that many air drilling problems *can* be overcome by boosting your regular air supply to higher pressures.

High pressure air will start a column of water moving from deep holes . . . blockages can be broken loose . . . continuous removal of water and cuttings can be easily handled. Boosters prevent overloads on your regular compressors . . . reduce maintenance costs. These advantages, coupled with new chemical developments in water shut-off techniques and removal of wet drill cuttings, mean that water is not the major obstacle it was a year ago.

The Schramm Turbocharged, Diesel driven Model 2-A Booster shown here is a heavy duty, continuous service unit designed especially for oil field service. It will take 1800 cfm of air at 100 psi from your regular compressors and boost it to 275 psi. At the flip of a lever, it will take 900 cfm of air at 100 psi and boost it to 500 psi. The natural gas or propane engine driven unit handles 1800 cfm at 200 psi or 700 cfm at 500 psi.

Flexibility of mounting arrangements. Schramm Oilfield Boosters can be provided to meet your requirements . . . skid-mounted, road trailer mounted, four wheel spring mounted or stationary as a power take-off unit.

Buy or rent. Schramm Oilfield Boosters and Compressors are available for rent or purchase. Contact your dealer or supply store.

Write for your copy of the new Schramm Air Drilling booklet.

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The mast is 92 feet high, with fingerboard for racking doubles. Mast capacity, properly guyed, is 150,000 lbs. Mast is raised by mast raising bridle and your regular blocks. 12 jacks are provided. Rig-up is fast and easy.

HERE'S A RIG THAT WILL MAKE YOU MONEY

Walker-Neer R-3-A

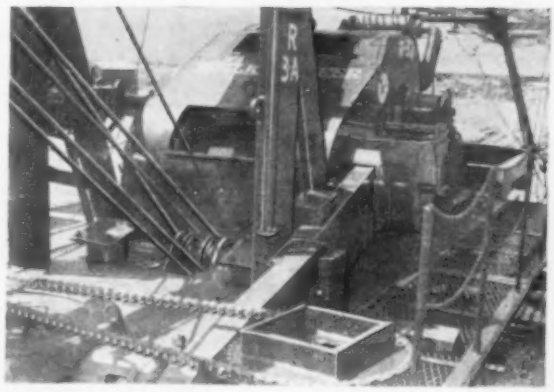
Trailer Mounted

Two Drum Rotary

3,000 ft.
with 4½" drill pipe

4,000 ft.
with 3½" drill pipe

6,000 ft.
with 2⅞" drill pipe

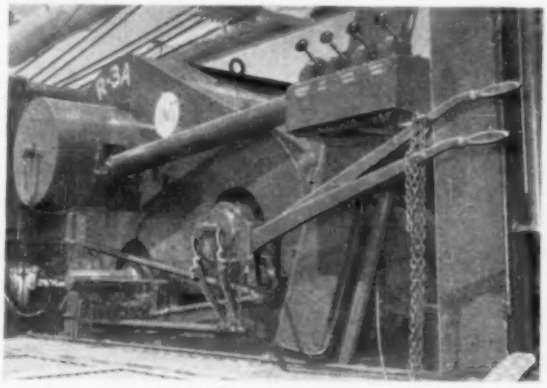


30" walkways are provided on both sides of the trailer. 3 stairways are provided. Note also the enclosed chain drive from drill drum shaft to rotary table, the rotary drive air clutch, the mast raising sheaves, and the rat hole drilling attachment.

Here is a heavy-duty rig that takes as little as three hours to rig up . . . has ample walkways and working area . . . is highly compact for fast, easy moves . . . combines air-clutch operation with full floating drums and air spinning cathead . . . priced low enough that you can really make money in 3,000-to-6,000-foot drilling. The design of this rig is ideal for workover and completion, as well as drilling.

Both drums, the rotary table, and the air spinning cathead are driven by modern Air-Tube Disc Clutches. The drum clutches are mounted in the drum ends. Each drum shaft is driven by high speed roller chain from the clutch shaft.

The R-3-A can be equipped with the power unit and torque convertor of your choice. It is also available with spudding beams, or in a single-drum rig.



The air control panel and drum brake levers are directly in front of the driller as he faces the drawworks and rotary table. The two levers at bottom operate the positive clutches which disengage drum shaft drive chains when not in use. Note the air spinning cathead on end of sand reel shaft.

In road position the walkways and floor extension fold up. This reduces the overall width to 108 inches and the overall length to 33 feet 9 inches.

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING

Feeleroop

PEOPLE WHO THINK that the oil business in the United States is just one big monopoly, and that there is no competition among American oil companies, ought to drive a car through Mexico. There they'd see how a real monopoly works.

There is just one oil company in Mexico—Pemex, the government-owned Petroleos Mexicanos. All the service stations in Mexico are Pemex stations, and the only brand of gasoline available is Pemex.

This makes for great efficiency. There is no duplication of facilities, no wastefully excessive number of service stations, no need to spend money on advertising, no competition in attracting motorists.

In fact, the distribution system is so efficient that service stations are located only where they are absolutely needed, and not always there. For instance, last summer we drove on one stretch of highway in Mexico that had 168 miles between filling stations, and in many other places it is 50 to 100 miles between opportunities to gas up.

The small towns in Mexico have no filling stations at all, and the medium-sized towns usually have only one. Once we airily passed up a station on the near side of a rather large city, figuring on catching one on the other side of town. But there wasn't another station, and after finding ourselves out in the country with only half a tank of fuel we had to turn around and go back.

Another time we were running low on gas in a fair-sized town and inquired for a Pemex station. We were directed many blocks up narrow, cobblestone streets to the town's only filling station, far off the main highway. There we had to queue up behind a line of cars and trucks and wait our turn. It took us a full half hour to locate the station and buy a tankfull.

There's no competitive octane race in Mexico, either. Pemex has two grades of gasoline—regular and super. The super is 80 octane, which is lower than almost any regular sold in the United States. But the smaller stations don't handle super at all, and many of the others are apt to be out of it half the time. A third grade, 90 octane, is said to be available in some places, but we never could find any.

Mexico's economy is an interesting mixture of state capitalism and private enterprise. While Pemex has a monopoly on gasoline distribution, its stations are operated by independent businessmen. And Pemex apparently lets them be as independent as they please and doesn't try to enforce any standards of service. So where there is only one station in town it is apt to have nothing but a pump or two and the motorists get no service at all. But in the big cities the stations are highly competitive—clean, modern, bustling, and offering all the services of any American superstation. Some of them even have that Mexican rarity, rest rooms up to American standards of cleanliness.

When a car pulls into one of these stations about six guys jump on it. One grabs the hose and says "Feeleroop?" (which may be the only English word he has picked up from the tourists). Others pop open the hood, check the tires, and wash the windshield.

A curious mixture of competition and monopoly, neither pure capitalism nor pure socialism, running all through Mexico's business structure. Perhaps it's the best system for the Mexicans. Certainly it's their own system, and they like it that way, so we don't criticize.

But all through our 2,000-mile motor trip in Mexico we kept wishing that the Pemex operation could be viewed by those Americans who, on the one hand, think that the U. S. oil business is a monopoly, and, on the other, by those who think that there is too much competition here.

We prefer the American system. Maybe we do have more service stations than absolutely necessary, competing extravagantly in gasoline quality and clean rest rooms. Maybe American motorists are spoiled. But we like being spoiled.

If you ever drive your car in Mexico, where gasoline is a monopoly, never pass up even the crummiest looking filling station. It may be the only one in 100 miles.

—Henry D. Ralph.

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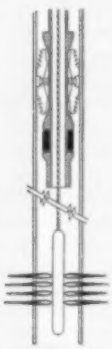

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SWAB AND TEST

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A

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B

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Swab and Test

C

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D

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Let's keep oil controls in the state commissions

THERE'S a plain lesson in the report of the Department of Justice on the operation of the Interstate Oil Compact Commission and the regulatory activities of its member states.

The department gives both a clean bill of health. It finds that the Compact has provided constructive leadership in conservation, helped to stabilize the industry, operated in the public interest, and made no attempts to control output or prices.

The state conservation systems—including the controversial market-demand proration—also get the department's blessing. It finds in them no evidence that monopoly is fostered, competition suppressed, or prices rigged.

BUT THEN THE REPORT turns to industry practices and conditions outside the activities of the Compact and the state regulatory bodies. It hints that competition between majors and independents is not as well balanced as it ought to be. It implies that some federal legislation may be needed.

As examples, the department cites unconnected wells, purchaser proration, and the relationship between buying crude oil and the operation of pipelines. It concludes that "the policies of the petroleum purchasers may have a greater influence on approximating production to market demand than do the state regulatory agencies."

This, in a sense, is an indictment of the state agencies—a different sort of indictment than was expected when Congress ordered the investigation. It is a strong implication that the states have shirked their responsibilities, have not been vigorous enough in exercising their legal powers over production and competition.

THE LESSON IS CLEAR. The Oil Compact and the state regulatory systems were established primarily under the compulsion of two factors: the need to protect competitive equities during a period of oversupply of crude, and the threat of federal control.

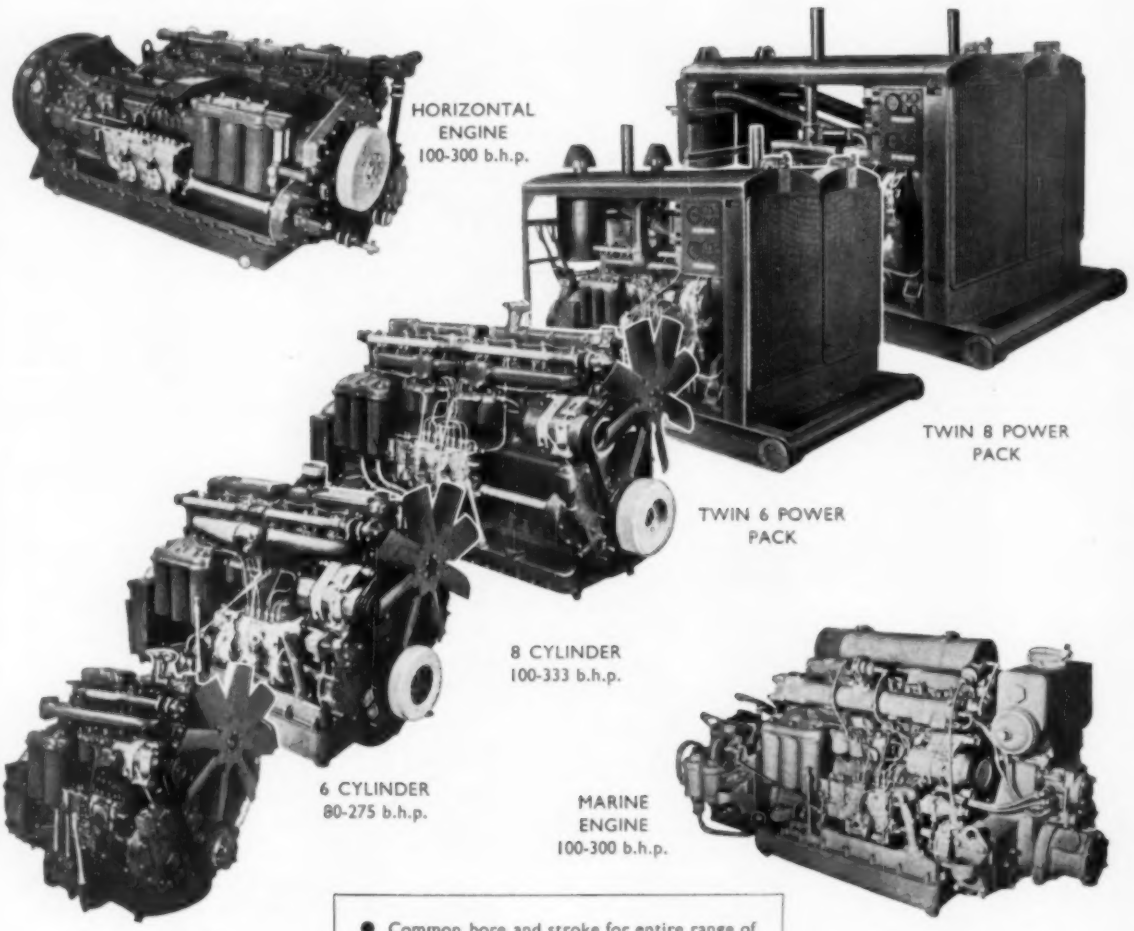
Those two factors are present today. Under the pressure of production cutbacks, weaknesses and sore spots are showing up in the proration systems of several states. Producers are complaining about the inequities and demanding action on many of the subjects mentioned by the Department of Justice.

So far the producers have not sought federal legislation. But there are those in Congress who will use this report to that end.

This can be avoided if the various state commissions will follow the course plainly invited by the Department of Justice. With or without the assistance of the Compact, the states can reassert their authority and correct many of the troubles which both producers and the department complain about.

ROLLS-ROYCE

OIL ENGINES



HORIZONTAL ENGINE
100-300 b.h.p.

TWIN 8 POWER PACK

TWIN 6 POWER PACK

8 CYLINDER
100-333 b.h.p.

6 CYLINDER
80-275 b.h.p.

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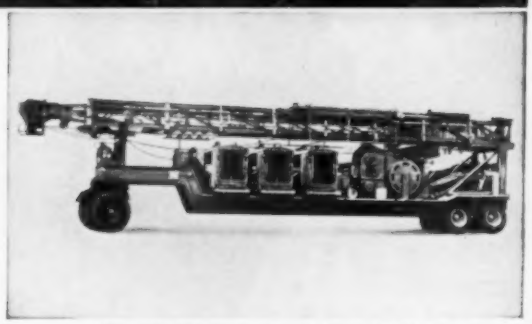
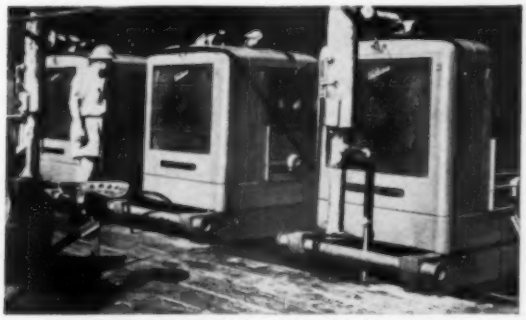


Woodfield Hoist Drilling Rig — Trinidad

Scammell Constructor — Ras Duqm, Oman

Woodfield Hoist Servicing Rig — Seria, Borneo



Petbow Generating Set — Seria, Borneo

C.P.T. Air Compressor — Iraq

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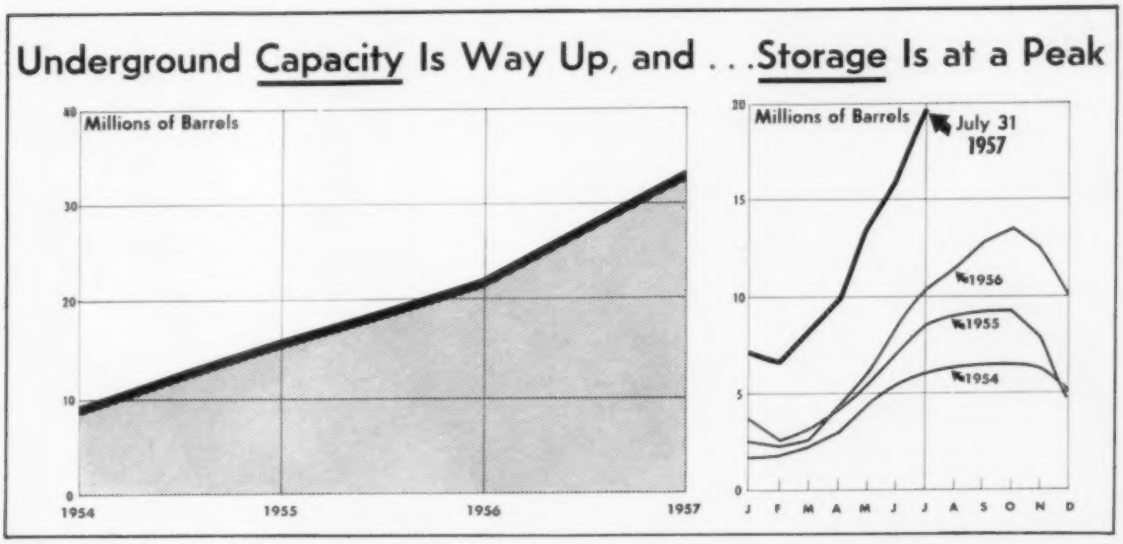


That means the . . .

L.P.G. Industry Is Ready for Winter

● Capacity of underground caverns jumped an amazing 35 per cent during the past year—to a new total of nearly 34,000,00 bbl. And the big boom will continue

Robert B. Bizal, district editor

LOOKING at its mushrooming capacity for storing L.P.G. underground, the industry this fall could ask itself: "What did we do without it?"

Born only 7 years ago, this type of storage has more than kept up with the rapidly expanding L.P.G. demand. In just the past year, in fact, the industry added another 11,691,510 bbl. of capacity, a jump of 34½ per cent.

The total is now 33,887,000 bbl.—enough to hold twice as much L.P.G. as was sold during the entire month of December last year.

A special survey by The Oil and Gas Journal shows the boom will continue next year and the year after that. Companies planning to develop new facilities and expand existing cavities already are figuring that their total ultimate capacity will be a staggering 57,068,000 bbl. (Table, p. 103.)

This is an 86½ per cent increase over what they forecast as ultimate capacity just a year ago.

Development of this underground capacity has resulted in a firmer supply and a more stable flow during peak winter months. It also has steadied the year-round price structure for a product which has more drastic ups and downs than other products.

Where it is

Most of the storage is in the oil-producing Southwest, but this year's Journal survey indicates a slight trend toward more storage in the heavily populated eastern part of the nation.

Ideally, the supply-demand picture could be healthier if it were possible to store more L.P.G. at the point of local distribution. But the eastern United States lacks the geological formations most conducive to cheap storage—salt domes and salt layers, which are plentiful in the Southwest.

Salt holds most . . . About 84 per cent of the nation's total storage capacity is in salt formations.

Salt is impervious and washes easily. More important, it costs only $1 to $3 per barrel to prepare a cavity. By contrast, it costs from $19 to $24 a barrel to use steel tanks for above-ground storage.

Mined caverns in impervious shale or chalk hold about 3 per cent of the L.P.G. stored underground. This type of storage costs from $3½ to $7 per barrel. These caverns hold great promise for the South and East, where salt layers are hard to find.

A third way to store L.P.G. is to inject it into oil, gas, or water sands. This method accounts for more than 12 per cent of the total U. S. capacity. But because oil and gas reservoir characteristics vary so much, it's impossible to fix the per-barrel cost.

Texas has the bulk . . . This year 53

Where L.P.G. Is Stored—and at What Cost

By type of storage:

Salt domes, salt layers:	28,609,000	$1 to $3 per barrel
Oil, gas, and water sands:	4,182,000	Cost varies
Mined chalk, shale, etc.:	1,049,000	$3½ to $7 per barrel
Miscellaneous*	47,000	Unknown
Total	33,887,000	

*Atlanta Gas Light Co.'s buried tanks

By states:

	Present capacity	Ultimate capacity		Present capacity	Ultimate capacity
Alabama	365,000	365,000	New Jersey		675,000
California	400,000	400,000	New York	580,000	950,000
Georgia	47,000	47,000	Ohio		60,000
Illinois	526,000	526,000	Oklahoma	300,000	300,000
Indiana		450,000	Pennsylvania		12,000,000
Kansas	1,863,000	2,260,000	Rhode Island		200,000
Louisiana	1,364,000	3,345,000	Texas	25,316,500	31,254,000
Michigan	680,000	865,000	Virginia		95,000
Mississippi	1,723,000	1,903,000	West Virginia		400,000
Missouri		25,000	Wisconsin		100,000
New Mexico	722,500	848,000	U. S. total	33,887,000	57,068,000

companies list 283 projects in 21 states. Last year they had 233 projects in 16 states.

New states in the Journal survey are Rhode Island, Pennsylvania, West Virginia, Indiana, and Georgia—all in the eastern part of the nation.

Texas storage dwarfs that of all other states combined. The leading oil and gas producing state now has an underground-storage capacity of 25,316,500 bbl. This is nearly 75 per cent of the national total.

The biggest concentration of storage in the country is in the Barber's Hill salt dome, about 25 miles east of Houston and near the point where the Little Big Inch line begins.

Here four companies have storage capacity totaling about 5,500,000 bbl., or about 16 per cent of the nation's total. The storage caverns are fast becoming a main cog in the Houston area's petrochemical complex (OGJ, Aug. 26, p. 72).

Kansas, second among the states, is far behind with 1,863,000 bbl. Only two other states are in the million-plus class: Mississippi, with 1,723,000 bbl., and neighboring Louisiana with 1,364,000.

Indiana's first underground-storage project will go into operation in 1959 when Northern Indiana Public Service Co. completes its project in La Porte County, about 30 miles east of Chicago. Excavation of this hard-rock cavern will begin early next year.

The cavern will hold about 450,000 bbl. of product, which will be withdrawn for blending with natural gas for distribution to customers.

Rhode Island's first L.P.G. storage is being provided by Suburban Propane Gas Corp. Suburban plans to store as much as 200,000 bbl. of propane in a mined cavern in Portsmouth County.

In Alabama, the nation's second mined-chalk storage was completed this year by Tuloma Gas Products Co. and Sinclair Oil & Gas Co. The two companies completed their first chalk cavern last year. Both caverns are near Demopolis and hold a total of 365,000 bbl. of L.P.G.

Since these are the first chalk storage facilities in the nation, the projects have been watched closely. The chalk has proved very successful, since it is impervious and requires no sealant.

Big projects coming

The biggest proposal for underground storage of L.P.G. is not in Texas, or even the Southwest. It's earmarked for Pennsylvania and West Virginia.

Underground Storage & Exploration, Inc., plans to develop these facilities:

... Six 2,000,000-bbl. caverns near Mauch Chunk in eastern Pennsylvania. The 12,000,000-bbl. total capacity would be more than twice that of Texas' giant Barber's Hill salt dome near Houston. The company plans to develop one mined-shale cavern a year for the next 6 years.

... Storage for 300,000 to 500,000 bbl. of L.P.G. near Moundsville, in eastern West Virginia. Target date for completion of this shale cavern is the 1958-59 winter season.

... A 393-mile pipeline from Moundsville, across Pennsylvania to Newark, N. J. It would have a lateral north to the Mauch Chunk storage area and another southeast to the Marcus Hook, Pa., refining area near Philadelphia.

The Moundsville project, plus one cavern at Mauch Chunk and the pipeline, will cost about $34,000,000. The other five Mauch Chunk units will cost another $26,000,000.

Petrochem project . . . Other new storage facilities could develop from a project planned by the Charleston Group companies of the Columbia Gas System, Inc. Plans call for a big $13,000,000 project near the West Virginia-Kentucky border.

This will include an $8,000,000 plant for extracting petrochemical feed stocks from natural gas. It will produce about 285,000 gal. of ethane, 186,000 gal. of propane, 65,000 gal. of butane, and 28,500 gal. of natural gasoline daily. Location will be in

Annual Journal Survey of Underground L.P.G. Storage Capacity

ALABAMA

County and type of storage—	Capacity in bbl. Present	Capacity in bbl. Ultimate	Product
Tuloma Gas Products Co.—Sinclair Oil & Gas Co.			
Marengo—Mined chalk	140,000	140,000	B-P mix
Marengo—Mined chalk	225,000	225,000	Propane

CALIFORNIA

Standard Oil Co. of California			
Los Angeles—Water sand	150,000	150,000	Propane
Los Angeles—Water sand	150,000	150,000	Butane
Los Angeles—Water sand	100,000	100,000	Propylene
Sunray Mid-Continent Oil Co.*			
Los Angeles—Oil sand			Propane

GEORGIA

Atlanta Gas Light Co.†			
Bibb—Buried tank	7,000		Propane
Clayton—Buried tank	1,000		Propane
Fulton—Buried tank	39,000		Propane

ILLINOIS

National Petro-Chemicals Corp.			
Douglas—Mined shale	170,000	170,000	Propane
Phillips Petroleum Co.			
Kankakee—Mined shale	260,000	260,000	Propane
Warren Petroleum Corp.			
Kane—Mined shale	44,000		L.P.G.
White—Mined shale	52,000		L.P.G.

INDIANA

Northern Indiana Public Service Co.			
La Porte—Mined rock		450,000	Liq. pet.

KANSAS

Cities Service Oil Co.			
Reno—Salt layer (3 caverns)	160,000	200,000	Butane
Reno—Salt layer (7 caverns)	395,000	525,000	Propane
National Cooperative Refinery Association			
McPherson—Salt layer (3 caverns)	150,000	150,000	Propane
McPherson—Salt layer (9 caverns)	325,000	440,000	Butane
Pan American Petroleum Corp.			
Grant—Salt layer (2 caverns)	53,000	53,000	Propane
Grant—Salt layer (6 caverns)	147,000	155,000	Butane
Phillips Petroleum Co.			
Kingman—Salt layer (3 caverns)	196,000	300,000	Propane, butane
Skelly Oil Co.			
McPherson—Salt layer (12 caverns)	437,000	437,000	Propane

LOUISIANA

Cities Service Refining Corp.			
Cameron—Salt dome	52,000	750,000	Butane
Cameron—Salt dome		250,000	Propane
Esso Standard Oil Co.			
Ascension—Salt dome	150,000	300,000	Butane
Ascension—Salt dome		150,000	Isobutane
Ascension—Salt dome		150,000	Propane
Ascension—Salt dome		200,000	Propylene
Ascension—Salt dome		300,000	Ethylene
General Gas Corp.			
Bienville—Salt dome	179,000		Propane
Bienville—Salt dome	131,000		Butane
Bienville—Salt dome	190,000		B-P mix
Gulf Oil Corp.			
St. Landry—Salt dome	142,000	200,000	Propane
Petroleum Sales, Inc.			
Evangeline—Salt dome (2 caverns)	200,000	200,000	B-P mix
Evangeline—Salt dome	75,000	100,000	Propane
Warren Petroleum Corp.			
Bienville—Salt dome	245,000		L.P.G.

MICHIGAN

Cities Service Oil Co.			
Kent—Salt layer (3 caverns)	265,000	450,000	Propane
Skelly Oil Co.			
Kent—Salt layer	125,000	125,000	Propane
Sun Oil Co.			
Wayne—Salt layer	90,000		Propane
Wayne—Salt layer	200,000		Butane

MISSISSIPPI

Anchor Petroleum Co.			
Forrest—Salt dome	190,000	250,000	Propane
Forrest—Salt dome	190,000	250,000	L.P.G.
Forrest—Salt dome	190,000	250,000	Butane
General Gas Corp.			
Forrest—Salt dome	36,000		B-P mix
Forrest—Salt dome	24,000		Propane
Skelly Oil Co.			
Forrest—Salt dome	128,000	128,000	Propane
Forrest—Salt dome	70,000	70,000	Butane
Warren Petroleum Corp.			
Forrest—Salt dome	895,000		L.P.G.

MISSOURI

Missouri Hydro Gas Co.			
Greene—Mined limestone		25,000	B-P mix

NEW JERSEY

Esso Standard Oil Co.			
Union—Mined cavern		300,000	Propane
Union—Mined cavern		375,000	Butane

NEW MEXICO

Atlantic Refining Co.			
Lea—Salt layer	50,000	50,000	Butane
Lea—Salt layer	50,000	50,000	Propane
El Paso Natural Gas Co.			
Lea—Salt layer (2 caverns)	89,000	100,000	L.P.G.
Gulf Oil Corp.			
Lea—Salt layer	67,500	75,000	Propane
Lea—Salt layer	30,000	50,000	Butane
Sacra Bros.			
Eddy—Salt layer (2 caverns)	51,000	72,000	Propane
Eddy—Salt layer	24,000	30,000	L.P.G.
Skelly Oil Co.			
Lea—Salt layer (2 caverns)	110,000	150,000	Propane
Lea—Salt layer	80,000	100,000	Butane
Warren Petroleum Corp.			
Lea—Salt layer	171,000		L.P.G.

NEW YORK

Anchor Petroleum Co.			
Steuben—Salt layer (3 caverns)	280,000	525,000	Propane
Steuben—Salt layer	100,000	175,000	Butane
Suburban Propane Gas Corp.			
Cortland—Salt layer	200,000	250,000	Propane

OHIO

Standard Oil Co. (Ohio)			
Allen—Mined shale (2 caverns)		60,000	Propane

OKLAHOMA

Carter Oil Co.			
Pontotoc—Abd. oil wells	175,000		L.P.G.
Shell Oil Co.			
Beckham—Salt layer	15,000	15,000	Propane
Sinclair Oil & Gas Co.			
Seminole—Mined shale	110,000	110,000	Propane

PENNSYLVANIA

Underground Storage & Exploration, Inc.			
Carbon—Mined shale (6 caverns)		12,000,000	L.P.G.

RHODE ISLAND

County and type of storage—	Capacity in bbl. Present	Capacity in bbl. Ultimate	Product
Suburban Propane Gas Corp.			
Portsmouth—Mined		200,000	Propane

TEXAS

Anchor Petroleum Co.			
Martin—Salt layer (4 caverns)	285,000	320,000	Propane
Martin—Salt layer	60,000	80,000	L.P.G.
Martin—Salt layer	60,000	80,000	Butane
Bay Petroleum Corp.			
Chambers—Salt dome (5 caverns)	1,250,000		Butane, propane
Cities Service Oil Co.			
Gray—Salt layer (2 caverns)	190,000	200,000	Propane
Gray—Salt layer	30,000	100,000	Butane
Midland—Salt layer		100,000	L.P.G.
Continental Oil Co.			
Reagan—Salt layer	46,000	50,000	Propane
Cosden Petroleum Corp.			
Howard—Salt layer	50,000	50,000	Alky. feed
Howard—Salt layer‡	20,000	40,000	Nat. gaso.
Dorchester Corp.			
Carson—Salt layer	55,000	60,000	Propane
Carson—Salt layer	35,000	40,000	Butane
Dow Chemical Co.			
Brazoria—Salt dome	500,000	500,000	Propane
El Paso Natural Gas Co.			
Ector—Salt layer (4 caverns)		240,000	L.P.G.
Reagan—Salt layer (10 caverns)	751,000	1,500,000	L.P.G.
Enterprise Petroleum Gas Co.			
Wood—Salt dome	120,000	120,000	Propane
Wood—Salt dome	120,000	120,000	Butane
Wood—Salt dome		120,000	Butane
Wood—Salt dome		120,000	Propane
Freestone Underground Storage Corp.			
Freestone—Salt dome	150,000	150,000	Propane
Freestone—Salt dome	70,000	70,000	B-P mix
Gulf Oil Corp.			
Crane—Salt layer	62,000	75,000	Propane
Crane—Salt layer	56,500	75,000	Butane
Jefferson—Salt dome (2 caverns)	400,000	400,000	Ethylene
Jefferson—Salt dome	160,000	160,000	Propane
Jefferson—Salt dome	285,000	285,000	Butane
Humble Oil & Refining Co.			
Waller—Gas sand	500,000		Butane
Waller—Gas sand	1,000,000		Ethane, propane
La Gloria Oil & Gas Co.			
Jim Wells—Sand (2 projects)	103,000	144,000	Butane
Jim Wells—Sand (2 projects)	167,000	172,000	Propane
Lion Oil Co.			
Scurry—Salt layer (4 caverns)	557,000	617,000	Propane
Scurry—Salt layer (2 caverns)	271,000		Propane
Scurry—Salt layer	124,000	150,000	Butane
Scurry—Salt layer	124,000		Butane
Llano Grande Corp.			
Cochran—Salt layer (2 caverns)	50,000	100,000	L.P.G.
Magnolia Petroleum Co.			
Jim Wells—Sand	150,000	150,000	Propane
Liberty—Salt dome	1,700,000	2,000,000	Butane, propane
Midland—Salt layer	100,000	200,000	L.P.G.
Pan American Petroleum Corp.			
Andrews—Salt layer (2 caverns)	117,000	117,000	Propane
Andrews—Salt layer	56,000	56,000	Butane
Ector—Salt layer (2 caverns)	94,000	170,000	Propane
Hockley—Salt layer (2 caverns)	157,000	165,000	Propane
Hockley—Salt layer		100,000	
Pecos Co.			
Midland—Salt layer (4 caverns)	200,000	200,000	L.P.G.
Phillips Petroleum Co.			
Brazoria—Salt layer (3 caverns)	991,000	1,500,000	Prop., but., ethylene
Ector—Salt layer	200,000	200,000	Propane
Hutchinson—Salt layer (11 caverns)	2,271,000	3,000,000	Propane, butane
Pure Oil Co.			
Andrews—Salt layer (3 caverns)	210,000	337,500	Propane
Jefferson—Salt dome	200,000	200,000	Butane
Reef Fields Gasoline Corp.			
Howard—Salt layer (4 caverns)	193,000	193,000	Propane
Howard—Salt layer (2 caverns)	82,000	82,000	Butane
Shamrock Oil & Gas Corp.			
Moore—Oil sand	1,602,000		B-P mix
Shell Oil Co.			
Ector—Salt layer	200,000	200,000	Butane
Yoakum—Salt layer (2 caverns)	400,000	400,000	Propane
Sid Richardson Gasoline Co.			
Winkler—Salt layer (3 caverns)	334,000		Propane
Winkler—Salt layer (brine well)	10,000		
Winkler—Water sand			Butane, propane
Skelly Oil Co.			
Carson—Salt layer (3 caverns)	235,000	250,000	Propane
Carson—Salt layer (2 caverns)	148,000	175,000	Butane
Southern Minerals Corp.			
Nueces—Oil sand	85,000	85,000	B-P mix
Standard Oil Co. of Texas			
Scurry—Salt layer (4 caverns)	106,500	115,000	Propane
Scurry—Salt layer	21,000	25,000	Butane
Sun Oil Co.			
Jefferson—Salt dome		100,000	Butane
Sunray Mid-Continent Oil Co.			
Scurry—Salt layer (3 caverns)	97,500	97,500	Propane
Scurry—Salt layer (2 caverns)	82,000	100,000	Butane
Texas Butadiene & Chemical Corp.			
Chambers—Salt dome (5 caverns)	1,400,000	2,800,000	Butane
The Texas Co.			
Hardin—Salt layer (4 caverns)	500,000	500,000	Butane
Scurry—Salt layer	92,000	92,000	Propane
Texas Natural Gasoline Corp.			
Chambers—Salt dome (3 caverns)	800,000	800,000	Butane
Glasscock—Salt layer	100,000	150,000	Butane
Harris—Salt dome (2 caverns)	500,000	500,000	Butane
Harris—Salt dome	250,000	250,000	Propane
Upton—Salt layer (4 caverns)	468,000	650,000	Propane
Upton—Salt layer (3 caverns)	290,000	450,000	Butane
Tuloma Gas Products Co.			
Fort Bend—Salt dome		312,000	Butane
Wanda Petroleum, Inc.			
Harris—Salt dome (2 caverns)	300,000	300,000	Butane
Warren Petroleum Corp.			
Chambers—Salt dome	2,014,000		Nat.-gas liquids
Smith—Salt dome	881,000		L.P.G.
Stephens—Mined shale	48,000		L.P.G.

VIRGINIA

Bottled Gas Corp. of Virginia			
Nelson—Abd. railway tunnel		95,000	Propane

WEST VIRGINIA

Underground Storage and Exploration, Inc.			
Marshall—Mined shale		400,000	L.P.G.

WISCONSIN

United Petroleum Gas Co.			
Pierce—Mined and sealed sandstone		100,000	Propane
Total	33,887,000	57,068,000§	

*Combination storage and miscible-phase displacement project. †Does not include aboveground storage. ‡Not included in total. §Includes present capacity when ultimate capacity is not shown.

Wayne County, West Virginia, near Kenova.

Columbia also will build a fractionation plant and storage facilities at Siloam, Ky. A pipeline will connect the two plants. Completion of the plants is due by December 1, 1958.

Pipeline effect

Plans for the Pennsylvania - West Virginia project were touched off this year after Texas Eastern Transmission Corp. was given federal authority to convert the Little Big Inch from gas to products service.

The 20-in. line will carry products, including L.P.G., from Beaumont, Tex., as far as Moundsville, 1,168 miles away (OGJ, July 1, p. 88).

The system is scheduled to begin movements this month in one of the most significant events in products pipelining since the war-born Little Inch was built in 1943-44.

The conversion of this line not only touched off the plans of Underground Storage & Exploration but also will act as a big stimulus to expansion of Gulf Coast storage facilities by enlarging the market for L.P.G. in the Midwest and possibly the East.

Other pipeline plans . . . Standard Oil Co. (Ohio) is involved in one plan for a long pipeline haul for L.P.G.

The company plans to buy 400,000 bbl. of normal butane from Phillips Petroleum Co.'s Borger, Tex., refinery for blending at its Lima, Ohio, refinery.

The product will be moved, starting this month, in weekly 20,000-bbl. batches from the Texas Panhandle to Lima, a distance of more than 1,000 miles.

Another long L.P.G. haul is that of Texaco-Cities Service Pipe Line Co. This involves moving L.P.G. commingled with crude oil from Tulsa to Grand Rapids, Mich.

The company recently completed a 170-mile, 6-in. L.P.G. line from East Chicago, Ind., to Lowell, Mich. The new 8,000-bbl. line will start making deliveries in the Griffith, South Bend, Ind., and Grand Rapids areas after November 1.

Tied in with the project are Cities Service Oil Co.'s three salt-layer storage facilities in Kent County, near Grand Rapids.

Effect of flooding

This year, for the first time, L.P.G. is being used in a big way to help boost recovery in oil fields.

The use of L.P.G. for miscible-phase displacement projects undoubtedly will increase demand for the product. Big projects already are under way in Texas, Oklahoma, New Mexico, and California.

This new flooding technique has hit its stride in field application probably faster than any other secondary-recovery method, and if new projects should be developed at the rate they have been announced within the past 6 months, the need for L.P.G. in producing areas will jump sharply.

As an example of how much L.P.G. is being used in secondary-recovery work, Magnolia Petroleum Co. plans to inject 1,500,000 bbl. of propane during the next year in its Parks Pennsylvanian project in West Texas (OGJ, Sept. 9, p. 58).

Sunray Mid-Continent Oil Co. is trying to combine miscible-phase displacement with L.P.G. storage in Newhall-Potrero field in California. So far, this is the only project of its kind.

The company began injecting 400 bbl. of propane daily into the zone last June, primarily to recover additional oil.

But Sunray pointed out that "because the oil zone . . . is still at relatively high pressure, backflow tests are contemplated to determine whether the propane can be reproduced with little or no contamination. . . ."

Whether the reservoir will lend itself to L.P.G. storage won't be known until the tests are made.

What's ahead

The boom in L.P.G. storage has been going on since the first L.P.G. went underground near Kermit, Tex., less than 7 years ago. Since then, the climb has been little less than fantastic (see chart).

In 1955 storage capacity increased 73 per cent. In 1956 the increase was another 40 per cent, and although the percentage increase was less this year, the increase in volume was greater than any other year.

How supply will react to demand this winter depends, of course, on the weather. Last year about 13,440,000 bbl. of L.P.G. was in underground storage just before the season began.

As the winter wore on, storage was drained to 6,786,000 bbl. by the latter part of February. The figure would have been much lower if cold weather had held.

Whatever the weather this year, the oil industry is banking heavily on underground storage to assure a continuous flow of L.P.G. And at this year's rate of growth in underground storage capacity, it's very likely that the storage boom will continue.

Ellison Test Set

Target depth for Oklahoma wildcat will be 24,000 ft.

ANADARKO, Okla. — Operators are ready to drill the long-announced deep-deep wildcat in southwestern Oklahoma.

Kenneth A. Ellison & Associates, Oklahoma City, and three companies plan to go to 24,000 ft. in search of Ordovician pay in Oklahoma's biggest unproductive structure—the Fort Cobb anticline.

Howell, Holloway, & Howell, Dallas, is assembling a new rig for the 1 Anadarko Basin near the center of a 40,000-acre block about 15 miles northwest of here. Howell and Ellison are principal owners of the block. Other participants are Gulf Oil Corp. and Tekoil Corp.

Ellison, who for months has spearheaded the giant operation, earlier this year estimated the test would cost from $1,500,000 to $2,000,000. If the well goes to its objective, it would be even deeper than the world's record hole drilled to 22,570 ft. by Richardson & Bass et. al at the 1-L-Humble-L.L.&E. near Port Sulphur, La.

Plans . . . Howell, operator of the test, has had experience at deep drilling, having sunk a number of high-pressure gas wells in South Louisiana—some to depths below 17,000 ft.

The firm plans to cut a large hole to permit setting 20-in. casing at 500 ft., 13¾-in. at 8,000 ft., and 9⅝-in. to 19,000 ft. From there, the operator will carry an 8⅝-in. hole to total depth where 7-in. casing will be used for completion. Drilling time is estimated at 12 to 18 months.

Geology . . . More and more operators are becoming interested in the search for Ordovician pay in the deep part of the Anadarko basin which runs northwesterly from southern Oklahoma to the Texas Panhandle.

The Fort Cobb anticline, which runs along the basin's trough, extends from northwestern Caddo County into adjoining Washita County. It covers about 90,000 acres.

The wildcat site is about 7 miles northwest of Superior Oil Co.'s 1 Weller that probed the anticline to 17,823 ft. in 1947 and held the world's title as deepest well at the time of its abandonment.

Nearest production is at Northwest Apache pool, 18 miles southwest of the new location, where production is from the Anadarko basin's Ordovician.

West Coast refiners must spend $5 million a year for 8 years to stay competitive. Here's how it should be spent:

	1957		1965				
	Bbl.	Per cent of crude capacity	Bbl.	Per cent of crude capacity	New capacity bbl.	Cost per bbl.*	Total cost
Crude Distillation	29,000	100	58,000	100	29,000	$1,000	$29,000,000
Catalytic Cracking	10,000	34	23,000	39	13,000	300	3,900,000
Catalytic Reforming	4,000	13	10,000	17	6,000	280	1,680,000
Hydrogen Treating	3,000	10	10,000	17	7,000	200	1,400,000
Alkylation	900	3	3,000	5	2,100	1,200	2,520,000
Polymerization	300	1	600	1	300	1,000	300,000
Isomerization	.....	.....	3,000	5	3,000	500	1,500,000
							$40,300,000

*Processing unit plus usual auxiliaries.

Big Adjustment Due Western Refining

● Some basic changes are in store. U.O.P. sees more cars, higher gasoline consumption, less residual, and a constantly changing crude-oil picture

PASADENA. — The average West Coast refiner in the next 8 years will have to double his capacity and expand other units if he is to stay in business.

This is the advice of two Universal Oil Products Co. spokesmen, S. W. Curry and D. O. Haag. And Curry and Haag place a $40-million price tag on the expansion.

Doubling refining capacity by 1965 is in line with the national trend. But Curry and Haag said West Coast refiners face some problems different than those found in the remainder of the country. A number of factors point up the difference:

. . . **Higher gasoline consumption** per capita than the rest of the country.

. . . **More cars.** The West Coast is experiencing a more rapid growth in the number of motor vehicles.

. . . **Residual yields.** Demand for residual has been decreasing, pointing to a need for keeping yields at a bare minimum.

. . . **Change in crude charge** stock properties.

Curry and Haag are members of U.O.P.'s research and economics department. They outlined their views on West Coast refining trends at the annual meeting for the California Natural Gasoline Association here last week.

What he'll need . . . Based on a theoretical "average" West Coast refinery of 29,000 bbl. daily basic crude capacity, Curry and Haag listed the following as necessary for the average refinery to stay in business in 1965:

. . . **Basic crude distillation** capacity doubled.

. . . **Cat cracking** and cat reforming a little more than doubled.

. . . **Hydrogen treating** and alkylation tripled.

. . . **3,000-bbl. daily isomerization** added where none now exists.

Spread over 8 years at an average yearly cost of $5,037,500, the total bill comes to $40,300,000 by 1965 (see table).

Curry and Haag based their figures on present-day cost of crude distillation units, and included such offsite facilities as tankage, laboratories, and terminals.

Why the increases . . . The five western states referred to in the report (California, Oregon, Washington, Nevada, and Arizona) are experiencing a higher growth rate than the rest of the country.

Western motoring habits resulted in a per capita gasoline consumption last year of 391 gal. The national average was 326 gal. This is typical of the trend toward a larger proportionate requirement for gasoline and distillates.

At the same time, there has been a decrease in the demand for residual fuels, and there are indications that this will continue. This is a result of the growth in use of natural gas.

The net result of the increased gasoline and distillate demand and decreased residual demand means the West Coast's gasoline demand will increase from 1956's 44.2 per cent of the products to 49.7 per cent in 1965. West Coast gasoline demand last year represented 13.8 per cent of the national demand. In 1965, it will climb to 15.4 per cent.

Tied in with the growth in vehicles is the premium fuel requirement picture. One estimate is that West Coast consumption of premium fuels is 50 to 60 per cent of total gallonage now. The West Coast R.O.N. pool is expected to hit 102.3 octane by 1965—

slightly higher than the national average.

Processing problems . . . The West Coast refiner will not only have to tailor his yields to meet increased and higher-octane gasoline and distillate demands, but he will have to do it with a constantly changing crude picture.

In 1956 average yields involved processing of 84 per cent California crude and 16 per cent imported crude. Present trends indicate that by 1965, charge stocks will consist of 50 per cent domestic and 50 per cent imported crude, Curry and Haag forecast.

This will probably result in increased paraffinic-base crudes run to refineries in contrast to the heavy asphaltic crudes now run.

Curry and Haag also predict that:

. . . **Straightrun gasoline** volume to be processed will be larger.

. . . **Volume of naphthas** for reforming will increase.

. . . **More propane and butanes** will show up in product streams.

. . . **Kerosine** and light straightrun distillate output will climb.

Shell Plans Line

To tie Louisiana's Delta area to refinery at Norco

HOUSTON.—Shell Pipe Line Corp. has announced plans to build a crude-oil pipeline from the Delta area of South Louisiana to Shell Oil Co.'s Norco, La., refinery.

Joe T. Dickerson, Shell Pipe Line president, said other companies may become participants. The line would be a common carrier originating at Shell Oil's Southwest Pass terminal near the mouth of the Mississippi.

Offshore fields in the Delta area currently produce about 80,000 bbl. of crude daily. This is approximately 60 per cent of the total current crude production in the Gulf of Mexico. Shell Oil is one of the area's major producers.

The trunk line is expected to be of 16 or 20-in. pipe and about 100 miles long. Dickerson said the exact length, size, capacity, and cost of the system cannot be determined until other participants, if any, are known.

The Norco refinery, onshore terminal of the proposed pipeline, is about 18 miles west of New Orleans. It has a capacity of 100,000 bbl. daily. Crude from fields to be served by the line is now going to refining or port facilities by barge.

watching WASHINGTON

. . . with Bertram F. Linz

Gas bill needs help . . .

CONGRESSIONAL supporters of the Harris gas bill may have defeated their own ends by their failure to push the bill through the House last session.

Dissension over civil rights, the approaching 1958 elections, and organized consumer resistance will face the measure when Congress meets again next January.

Sparked by Rep. Oren Harris of Arkansas, co-author of the bill, efforts are being made to whip up additional support. This new support would come from the coal-state delegations. But to get it, the bill will have to be revamped to provide for federal control of industrial gas sales.

Since this would require interstate pipelines to reverse their position, heavy and perhaps insurmountable resistance is expected to be offered to the idea. But in some quarters, both in and out of Congress, it is believed the concession will have to be made if the bill is to have any chance of passage.

Agencies fight back . . .

A CONGRESSIONAL probe of the Federal Power Commission and other regulatory agencies has run into a roadblock.

Rep. Morgan M. Moulder of Missouri, chairman of a special House commerce subcommittee, says the Civil Aeronautics Board and the Securities and Exchange Commission have refused to open their files to staff investigators. And he thinks this may be the first step in a plan to block the investigation, which is expected to open in Congress next January.

The Federal Trade Commission and Interstate Commerce Commission are also expected to come under fire. The general charge against the agencies is that they are too easy going, that they listen too closely to the industries they regulate.

Moulder will hold a hearing this week to go into the CAB's refusal to open its files. He may also call SEC officials to explain their position.

House Speaker Sam Rayburn is said to be personally interested in the probe. He played a role in setting up some of the agencies. He wanted the study made last session, but the House commerce committee couldn't find the time for it.

Offshore trouble shooter . . .

PRESIDENT TRUMAN'S 1945 assertion of U. S. ownership of the Continental Shelf has raised a number of problems in international sea law. Next February, the United Nations international law commission will meet in Geneva for a third effort to iron things out.

The problems include not only the rights and protection of navigation by sea and air, but also such matters as oil development and sponge and shell fishing. The oil industry, of course, has the biggest stake. It could be seriously affected by changes in the law, which probably will be expressed in multilateral treaties.

Looking to the future, the Geneva meeting will consider expansion of the term "continental shelf." It would include in that definition not only the shelf to the 600-ft. water depth but also other areas where the depth would permit development in the same way as if there were a shelf.

The commission foresees the possibility that future developments may make it possible to drill in water depths over 600 ft., either directly or by slant drilling from the shelf. But it admits that this would increase the problem of settling international boundaries, as in the case of the United States and Mexico.

The committee has already turned down a suggestion to internationalize the submarine areas. This would raise impossible practical difficulties, and would not insure effective exploitation of natural resources, it said.

Newcomers Give Import Policy A Test

- **Houston refiner seeks 20,000 bbl. daily first quota, Carson hints this will be cut to less than 12,000 bbl.**

- **Control policy may be extended if West Coast imports get out of line or Caribbean processors become problem**

WASHINGTON.—The oil industry will learn this week how the Government will deal with refiners wanting to import foreign crude for the first time.

The initial test of this phase of import-control policy is faced by Administrator M. V. Carson in the application of Crown Central Petroleum Corp. This refiner has asked for permit to bring in 20,000 bbl. daily of foreign oil for its Houston refinery.

The cabinet committee's July 29 report sets out the basic policy. It says that additional refiners may be brought into the import picture. But the amount they may import is limited to 12,000 bbl. daily.

Carson agrees there is no legal ground for barring newcomers. But he cannot give Crown Central the 20,000-bbl. quota it asks. There are indications he will give the company much less than the 12,000-bbl. maximum set by the committee.

The administrator outlined his views on newcomers earlier this month before the National Petroleum Council. He warned a rush to import on the part of refiners who previously have filled their needs with domestic oil would defeat the purpose of the program to protect the domestic producers.

What's happening . . . Other developments during the week involving the imports-control program included:

. . . Higher quotas were given only two of seven importers who requested them. The increases were allowed to correct errors in the basic figures.

. . . West Coast exemption from restrictions will be reviewed before the end of the year by the cabinet committee. The committee then will have before it Carson's comment on recommendations of West Coast interests that imports be cut back by more than 100,000 bbl. daily.

. . . New refineries in Caribbean area built to make products for export to the U. S. will be considered an evasion of the import program. Carson warned such a move could lead to extension of controls.

The administrator has received no such plans by refiners. There are reports, however, that some interests—one group in Panama among them—are thinking in terms of new foreign plants to supply the U. S. markets.

Corrections . . . The two companies getting increased quotas were International Refineries, Inc., and the Northwestern Refining Co.

Both argued that the low quotas given them originally resulted from errors in the basic figures on which their allowables were set.

International asked for a 4,100-bbl. increase but got 1,350 bbl. more. Northwestern was given the full amount of its request for 3,500 bbl.

Requests of Sinclair Refining Co. and Eastern States Petroleum & Chemical Corp. were denied, however. The companies together with Standard Oil Co. (Ind.), Tidewater Oil Co., and Standard Oil Co. (Ohio) requested increases on the basis of hardship. All their appeals were denied.

Carson explained his stand on such applications in his decision in the case of Indiana Standard, the first to be released. While individual decisions will be written on each of the five cases, the others are expected to follow the pattern of the Indiana opinion.

"The voluntary oil import program inevitably will require adjustments on the part of many importing companies, and in complying with the program some economic losses undoubtedly will be incurred," Carson said. "Nevertheless, the importing companies have been requested to comply with the program in the interests of the national security.

"In these circumstances it is clear that my authority to alleviate inequities in the application of the program extends only to adjustments in instances of error or of exceptional or unconscionable hardship. In my judgment the petitioner has not presented a case which falls within either of these two categories."

Carson found that Indiana Standard's quota will permit it to fill almost 60 per cent of its East Coast refinery demand with foreign crude. The average of East Coast demand supplied by foreign crude or products is 35 per cent, he pointed out.

Thus Indiana Standard is not "suffering extraordinary hardship" with respect to its competitors, Carson held. In fact, he said, it is in a position of "relative equality."

Carson said he would lay before the cabinet committee the company's proposal to scrap the present control for a plan giving all refiners east of the Rocky Mountains a 9.6 per cent allowance of foreign crude.

The administrator said he had no authority to adopt a formula differing from that set by the cabinet committee. His responsibility, he said, is to administer the program set up by the committee and approved by the President.

How program goes . . . Indiana Standard already has announced it will accept Carson's decision and go along with the program.

So far, Carson has received no word from the other four companies.

If all the protesting companies cut their imports, Carson said, the program will be a success. It will pull imports down very close to the 755,700-bbl. target by early next year.

Cabinet committee review of the West Coast situation by the year end was provided for in its July 29 report. But Carson will review the material submitted by the West Coast producers 10 days ago and send his views along to the committee for its consideration.

The 296,000 bbl. daily allowed District 5 was considered high by the committee. But it said there was reason to believe that actual imports during the last half of 1957 would not exceed 275,000 bbl. a day.

"This situation should be reviewed, however, during the latter part of 1957 from the point of view of the plans of importers for the first half of 1958, in view of the fact that additional pipeline capacity to the West Coast is scheduled to become available during the first half of 1958," the report said.

Policies attacked . . . Oil imports, meanwhile, continue to be the subject of study at the capitol.

A House ways and means subcommittee last week released some 50 papers submitted from a number of industries dealing with the Government's foreign trade policy. These in-

cluded one from Russell B. Brown, general counsel of the Independent Petroleum Association of America.

The subcommittee will hold a series of panel discussions on these papers in December. Its report next year may decide whether Congress will extend the Trade Agreements Act, which expires next June 30.

Brown leveled a number of charges against the present trade policy, going back to 1939 when, he said, the import excise taxes on oil were reduced in defiance of congressional denial of the President's right to do so.

The result of successive government actions has been to increase imports steadily over the past 20 years, Brown said. Efforts of the I.P.A.A. to secure relief "have been repeatedly circumvented or ignored by the executive branch," he charged.

Brown also complained that the General Services Administration bypassed the Buy American Act when it granted an exception for oil in 1954. The Defense Department recently bought 8 million barrels of jet fuel in the Caribbean area under that exception.

300 cobalt-60 coins . . .

sealed in a case by remote welder give . . .

Hottest Atomic Tool for Esso Researchers

ESSO RESEARCH & Engineering Co. has replaced its gamma radiation source at the Linden, N. J., "hot" laboratory with a stronger new supply of cobalt-60.

The new source consists of 300-odd nickel-plated cobalt coins irradiated to a strength of 15,000 curies. They comprise the most powerful radiation source ever shipped from Oak Ridge for private industry use.

Original radiation source at Linden was a foot-long section of cobalt pipe which had picked up 3,100 curies by soaking in the Atomic Energy Commission's reactor at Brookhaven National Laboratories. When delivered to Linden in June 1955, the pipe also was the hottest thing of its kind in private research.

Demand for the cobalt pipe in research, however, outstripped its capacity by early this year. Even around-the-clock operations couldn't reduce the backlog of projects coming from Esso Research and its affiliates.

Atomic speed up . . . The stronger source of radiation will greatly expedite research work now.

Esso's new cobalt-60 has a strength roughly six times that of the decayed pipe. It will cut exposure time for many projects. More important, it will permit new investigations previously impossible to carry out. Radiation intensities approaching those obtained from nuclear reactors themselves are now made available.

The cobalt coins are about half the diameter of a dime and twice as thick. They are packaged in four thin rectangular steel holders 9 in. long, 2½ in. wide, and less than ¼ in. thick.

Esso developed an automatic remote controlled welding machine which A.E.C. used to seal the containers. They arrived in Linden encased in a large lead cylinder or "pig" weighing several tons.

The coins will give Esso a heavy dose of radiation for some time to come. Cobalt-60 decays at a relatively slow rate, losing half of its original strength every 5.3 years.

The results . . . Esso already is showing tangible results in its radiation research program.

A number of patents have been filed. Among them are two for processes making lube-oil additives.

Some interesting results also have been obtained by studying effect of gamma radiation on thermal cracking. At comparable conditions, addition of gamma radiation speeds up the thermal-cracking reactions. Radiation also starts thermal-cracking reactions at temperatures 50 to 100 degrees lower than those required to start cracking under conventional conditions.

Scientific importance is attached to this proof that radiation-induced free radicals spark the chain reactions involved in thermal cracking. No commercial applications have been indicated yet.

Katy, N.Y. Central Study L.P.G. Line

● Railroads would build project from Houston to Midwest and East, make use of right-of-way

NEW YORK.—The Katy and New York Central railroads have launched a study for the most ambitious L.P.G. pipeline project ever undertaken.

It would be a 2,000-mile system estimated initially at 10 or 12-in. from Houston to New York (see map). The railroads have retained Williams Brothers Co., Tulsa pipeline engineers and constructors, to make a feasibility survey. If results are favorable, a route survey will follow.

W. K. Warren, chairman of Warren Petroleum Corp., is a member of the Katy (Missouri-Kansas-Texas railroad) board. The Warren company, one of the nation's largest manufacturers and marketers of natural gas liquids, is assisting in investigating feasibility of the project.

The proposed project points up two trends in pipelining:

. . . **Increased pipeline movement** of L.P.G.

. . . **Entry of railroads** into the pipeline business.

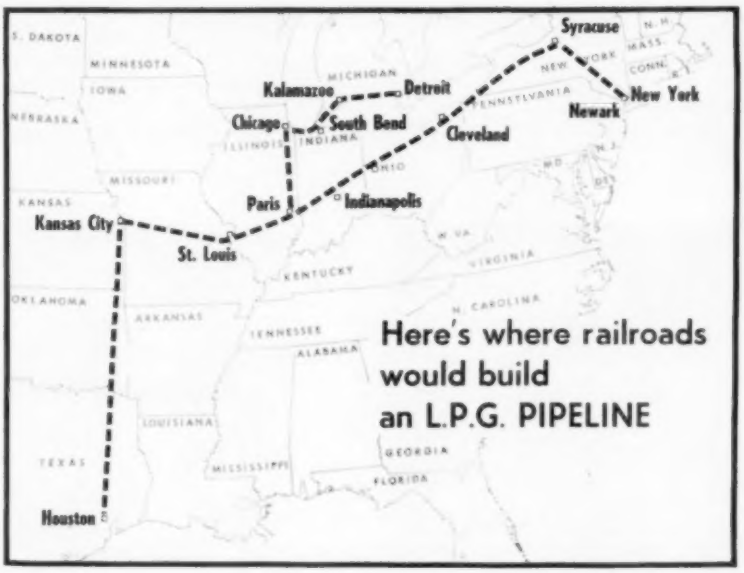
The railroads would take advantage of two important assets—right-of-way and communications facilities. These are their aces in a bid for a share of the pipeline transportation business.

Here is the tentative route: from Houston to Kansas City to St. Louis along the Katy Railroad; and thence to Paris, Ill., near Terre Haute, Ind., on the New York Central. At that point the line forks, with one leg going to Chicago, South Bend, Kalamazoo, and Detroit, and the other to Indianapolis, Cleveland, Syracuse, and perhaps New York City or Newark, N. J. From St. Louis north and east the line would follow the New York Central route as far as possible.

An extension from Cleveland to Pittsburgh is being considered.

Railroads once were the major carriers of petroleum and its products. Loss of most of this volume to pipelines has forced the railroads to take a belated look at pipelining to see whether they should enter the business.

Southern Pacific Pipe Lines, Inc., is the outstanding recent example of how a railroad has parlayed its right-of-way and transportation know-how into a successful pipeline. The company is operating an El Paso-Phoenix and Los Angeles-to-Phoenix products system, and is completing another products line from San Francisco to Fallon, Nev. Great Northern Railway is firming up plans for a crude pipeline along its right-of-way from the Williston basin to the St. Paul-Minneapolis area.



Railroads now haul the bulk of L.P.G. transported in this country. However, with the increasing motor fuel, heating, and petrochemical markets for this low-priced product, pipeline movement with its economy is becoming more attractive. The railroads, taking a lesson from the past, are moving to hold onto this important freight—whether it is hauled in their tank cars or their pipelines.

Line plans . . . The proposed 2,000-mile line would move either propane exclusively or propane and butane. If propane only is shipped, the storage problem, which has been a deterrent to pipelining of L.P.G., would be eased. Buyers could take directly from the pipeline at stations without the need for so much bulk storage. High-pressure storage to handle the volatile product is very costly unless underground storage is constructed. (See related story, p. 101.)

The railroads plan to use cavern storage, where salt or rock formations suitable for mining are available. Shippers or railroads, or both, would own the storage. A single in-transit rate would be charged, including layover storage.

Construction of the cross-country system will hinge largely on industry response. If marketers and shippers are interested, then the project is likely to go ahead. If the industry gives a cold shoulder to the proposal of this group of "outsiders," then their alternative will be to build a line without guaranteed throughput. They would have to count on getting business by offering a rate that would be too attractive for marketers to turn down.

L.P.G. pipelines . . . Long-distance pipelining of L.P.G., though not widespread, has proved economical.

It has been piped in several different ways: In batches through regular products lines, such as the Phillips Pipe Line Co. systems from Borger to Denver and Borger to Chicago; commingled in the crude stream, as Phillips, Magnolia Pipe Line Co., Gulf Refining Co., Shell Pipe Line Corp., and others have done; and through a combination of products, crude, and exclusively L.P.G. systems.

The Little Big Inch products line, which will start up this fall, pending a U. S. Circuit Court decision, plans to carry L.P.G. The railroads' line would have to compete with this 20-in. system, which also has Houston as its point of origin and serves much of the same area to be traversed by the L.P.G. line.

Other proposed L.P.G. lines have been studied recently. Routes considered are West Texas to Chicago, and West Texas to Houston, for transshipment on the Little Inch.

Gas Plan Gets Nod

Big project would deliver more gas to Chicago area

WASHINGTON.—A package deal to provide an additional 485,000 M.c.f. of gas daily to the Chicago area was recommended last week by a Federal Power Commission examiner.

Five pipelines are involved in the $182-million project, which is subject to final approval by the FPC. Here's what plans call for:

... **Pacific Northwest** Pipeline Corp. would build facilities at a cost of $5,577,750 to double the 117,700 M.c.f. of gas it now sells Colorado Interstate Gas Co.

... **Colorado Interstate** would build about 700 miles of line and 60,980 compressor horsepower at a cost of $86,934,900 to deliver up to 460,000 M.c.f. daily to Natural Gas Pipeline Co. at Beatrice, Neb. Colorado will drop 50,000 M.c.f. which it now delivers to Natural at another point.

... **Natural Gas Pipeline** would build 415.7 miles of 36-in. loop between Beatrice and Joliet, Ill., and supercharge 86 mainline compressor engines at a cost of $76,199,000. This will increase its system's capacity by 450,000 M.c.f. daily.

... **Texas Illinois** Natural Gas Pipeline Co. will sell all its gas to Natural, and Natural will become the sole seller to its own customers and Texas Illinois customers.

... **Chicago District Pipeline** Co. would loop its lines between Joliet and Chicago at a cost of $13,000,000, to increase its capacity by 456,000 M.c.f. daily. This company, Natural Gas Pipeline, and Texas Illinois are all affiliates in the Peoples Gas, Light & Coke Co. system.

This entire project is separate from competitive proposals to serve the upper Midwest, involving the Peoples group; Tennessee Gas Transmission Co., which would import gas from Trans-Canada Pipe Lines, Ltd.; and other major transmission companies serving this area.

Hearings on these proposals are still in progress before the FPC. The case is not expected to be settled for some time. Appeals through the courts are considered a certainty unless a compromise is reached.

Processing briefs

Extension of a rapid tax writeoff for Commerce Oil Refining Corp.'s proposed 43,000-bbl. refinery near Jamestown, R. I., has been denied by ODM. But the denial will not affect plans for construction of the plant.

ODM's action did not come as a surprise to Commerce, but the company was surprised at one of the reasons for the denial. ODM said the refinery would interfere with operations of two naval installations in the area. Commerce points out that the Navy has already given approval for construction of a refinery dock.

Du Pont has started design work on a proposed plant to produce linear polyethylene resins. Robert L. Hershey, general manager of the company's polychemicals department, said the plant is being considered for a 600-acre site on the Mississippi River near Laplace, La. Du Pont has been producing the new resin in experimental quantities during the past 2 years.

Cities Service Oil Co. has bought the Lehman gasoline plant in West Texas from Llano Grande Corp., Houston. The plant, which serves West Levelland pool in Cochran County, has capacity of 25,000 M.c.f. of gas daily. It was built by Tellepsen Construction Co., Houston, in 1955.

Suntide Refining Co.'s 75,000-bbl. plant at Corpus Christi will be shut down this week for cleanout and turnaround. The 1-month operation will be the first major shutdown for the plant since it went on stream early in 1954. The refinery has been running about 15,000 bbl. below capacity.

Suntide recently put two new units on stream, including one of the largest catalytic reformers built for an independent refiner. The units include an 11,000-bbl. U.O.P. Rexforming unit, consisting of a U.O.P. Platforming section and a Udex section, and a 6,000-bbl. Unifining unit. The Platformer will be operated on a blocked basis—part of the time to produce a motor-fuel blending component in excess of 100 leaded octane, and the rest of the time to make high-purity benzene, toluene, and xylenes.

McColl-Frontenac Oil Co., Ltd., has put its second U.O.P. Platformer on stream, a 3,300-bbl. unit at the 11,700-bbl. Edmonton refinery. The unit is processing straightrun naphtha derived from Alberta crude. It is designed to produce a 98 leaded-octane blending component. McColl also is operating a 12,000-bbl. U.O.P. Platforming unit at its 55,000-bbl. Montreal East refinery.

Anderson-Prichard Oil Corp.'s new 5,000-bbl. U.O.P. fluid catalytic cracking unit is on stream at the firm's 11,000-bbl. refinery at Cyril, Okla. The new unit, which processes atmospheric and vacuum gas oils, operates at 75 per cent conversion, and has a coke-burning capacity of 7,000 lb. per hour.

The new addition is a final step in the plant's extensive modernization program. Erection of the cat cracker and new gas concentration facilities, and revamping of existing crude, vacuum, and polymerization units were handled by Procon, Inc.

Lion Oil Co., a division of Monsanto Chemical Co., plans to add a 5,000-bbl. combination hydrogen treating and catalytic reforming unit at its El Dorado, Ark., refinery. A 100,000-lb. per hour steam boiler will also be built at the refinery. Construction will begin early next year with completion slated for late 1958. The unit will be the first of its type to be installed at Lion's plant.

Also for Refiners . . .

IN THE NEWS: Capacity of L.P.G. storage jumped an amazing 35 per cent during past year and current projects will push it even higher (p. 101) . . . Two U.O.P. researchers claim the average West Coast refiner must double his crude capacity and expand other refining units within the next 8 years to stay competitive. They say it will cost each refiner $40,000,000 to make these expansions (p. 106) . . . Refiners wanting to import for first time provide new test for import-control policy (p. 108) . . . Esso replaces its radiation source at Linden lab with one even hotter (p. 109).

PLUS THESE TECHNICAL REPORTS: How to cut down on hydrogen blistering in cat-cracker gas plants (p. 222) . . . and The Foreman's Page (p. 226).

Highlights of Dallas A.I.M.E. Meeting

● What's new in all industry divisions was discussed in technical sessions at this important meeting. Here are abstracts of many of the significant papers:

Drilling

● **High-speed low-torque drilling device** of Humble Oil & Refining Co. was described by George E. Cannon. Research was originally handled by an outside concern on a contract basis. Under this development contract three tools were built and considerable laboratory and field testing was done.

Last year this tool was licensed to a bit manufacturer, and a development agreement was signed with Humble. Under these agreements two tools have been built which have been subjected to one lab test and seven field tests. A considerable history of mechanical failure has been developed, but the latest field tests show that a commercial tool will almost certainly evolve from this project.

The basic tool involves a wheel set with tungsten carbide cutters about its periphery, to drill rock when rotated about its axis with a flexible shaft drive. The entire unit rotated about an axis 90° to the wheel axis.

● **Effect of pressure on rock drillability** has been investigated for a laboratory drilling rig by John R. Eckel, Humble Oil & Refining Co.

Of primary importance are investigations of the effect of fluid properties on drilling rate, the effect of pressure on rock drillability, and a study of the fundamental mechanics of rock failures and chip generation.

Tests with air drilling have indicated that increased drilling rates achieved in the laboratory have resulted through no characteristic of the air other than its relatively low static pressure at the bottom of the hole.

Air and water exhibited similar drilling characteristics when used at near equal static pressures and when circulated with sufficient volume to provide ample hole cleaning. Air favorably affected drilling rate only when compared to water at high static pressure, all other conditions remaining constant.

Pressure tests with limestone have shown that drilling rate in that rock is substantially affected only by the differential between the hydrostatic pressure and the formation pressure. A differential in either direction causes a reduction in drilling rate, but an increase of hydrostatic pressure over formation pressure has a much greater effect than a differential in the opposite direction.

● **Coring unconsolidated oil sands** can be improved through using a new core barrel design described by A. B. Hildebrandt, H. C. Bridwell, and J. M. Keliner, Carter Oil Co. The rubber-sleeve core barrel was developed to improve core recovery from unconsolidated sands where it is most difficult to obtain core with conventional barrels.

Tests run in shallow experimental holes and in drilling wells in the U. S. and Venezuela have, to a large extent, proved the operation of the barrel. Internal mechanism troubles, such as sand binding of the sleeve, have been largely overcome. Cores have been recovered from completely unconsolidated sands where conventional coring has almost been abandoned because of poor recovery. The barrel gives a "packaged-as-cut" core, convenient for handling and transportation.

● **The "cutting carrying" capacity of air,** at medium pressures, has been analyzed by Kenneth E. Gray, The California Co. The author showed the advantage, in terms of horsepower requirements, of cycling high-pressure air to obtain lower compression ratios, by sample calculations based upon velocities necessary to lift actual air-drilled limestone cuttings.

Inasmuch as compressor costs are directly related to compression ratios, it would seem advisable, where possible, to cycle high-pressure air to obtain lower compression ratios. However, to cycle the high-pressure air, it would be mandatory that all the cuttings and dust be removed from the air prior to its return to the compressors for repressuring. Otherwise, the dust in the air would ruin the compressors in short order.

Gray recommends that a cyclone separator, to be used in conjunction with a high-pressure filter system or water spray, be developed for this application.

● **Clear water for drilling.** J. P. Gallus, J. L. Lummus, and J. E. Fox, Jr., Pan American Petroleum Corp., reported that fresh water or brine drilling fluids may be kept free of suspended drilled solids by the addition of a water soluble acrylamide-carboxylic acid copolymer at the flow line.

Addition of from .01 to 0.2 lb. per barrel of the polymer solution to drilling fluids containing less than 5 per cent clay solids by weight causes the solids to flocculate and settle rapidly to the bottom of the pits. Solutions of the polymer injected at the pump suction will reduce the loss of water to permeable formations without impairing the permeability to oil.

The use of drilling fluids clarified with the polymer has resulted in increased drilling rates, extended bit life, and lower drilling fluid costs.

Production

● **Electronic computers** have even been pressed into service to forecast the best profitability for operating oil fields. J. S. Aronofsky and A. S. Lee, Magnolia Petroleum Co., have applied the new mathematical technique for finding the best method of operating a process or system—called linear programing — to crude - oil production problems.

The particular problem worked out specifies at what rate crude oil should be produced from four different reservoirs, or purchased from an outside source, to realize a maximum profit. The method is devised to handle the nonlinear effects which reservoir pressure decline has on the ability to produce oil.

● **Calculating profitabilities** were detailed by F. Brons and M. W. McGarry, Jr., Shell Oil Co. Some "problems and answers" worked out by their methods include the following:

Problem 1. A well, drilled at a cost of $100,000, is expected to yield a total income of $200,000. The initial rate of income is $200 per day; the abandonment rate is estimated at $4 per day. The decline is assumed to be hyperbolic.

Determine the present-day value of

SECONDARY-RECOVERY papers were read to a packed house at the A.I.M.E. meeting. Here J. R. Kyte explains a Carter Oil Co. study of linear flooding in a water-wet reservoir during the water-flood session in the Baker Hotel. Miscible-phase displacement also was the subject of a number of papers.

the total profit (based on interest rate of 5 per cent) and also the internal rate of return.

Answer 1. $65,800, and 27 per cent.

Problem 2. A capital investment of $100,000 yields a constant income of $20,000 per year over a period of 10 years. After 10 years a single income of $40,000 is realized through salvage. What is the present-day value of the profit (interest rate 5 per cent per annum), and what is the internal rate of return?

Answer 2. $81,680, and 18 per cent.

● **The same principles** apply both for appraising producing properties and for analyzing profit expected from a proposed capital expenditure, J. J. Arps, British-American Oil Producing Co., told the economics-management session.

In each of these problems, projections of future cash income are compared to one or more capital expenditures.

Several methods have been used either to compute a price which will yield a given earning power on an investment or to arrive at an earning power which will result from a given capital expenditure.

One of the best, simplest, and least-known methods generally, Arps said, is the "average annual rate of return" method. This method computes the ratio of the present value of undepreciated balances of the investment over a project's life.

It has some unique advantages in that it cuts the computation work otherwise required, eliminates trial and error solutions, and provides more accurate answers.

Recovery

● **In situ combustion.** The process variables involved in "fire flood" work were reported by W. L. Martin, J. D. Alexander, and J. N. Dew, Continental Oil Co. The Conoco men also gave a rundown on past work and current projects.

Recovery of petroleum by a combustion or heat-wave process is not a new idea. F. A. Howard was granted a patent in 1923 on a process in which air and a combustible gas were pumped into an injection well and ignited. Russian engineers reported on field experiments with a crude oil gasification process in 1935. Other known early field tests include those conducted near Bartlesville and Ardmore, Okla., in 1942.

More recently completed field tests include an inverted seven-spot by Sinclair Oil Co. in Delaware - Childers field, Nowata County, Oklahoma; a three-well and an inverted five-spot test by Magnolia Petroleum Co. in Jefferson County, Oklahoma; and a test by California Research Corp. in Irvine - Furnace field in Kentucky. Worthington Corp. has completed a test with Forest Oil Corp. in Clark County, Illinois.

Several field tests are now in progress. Sinclair has acquired a 600-acre lease in Humboldt-Chanute field, Allen County, Kansas, and is carrying out a large-scale operation.

Three field tests are under way in California. General Petroleum Corp. is conducting an inverted five - spot pattern test in South Belridge field, Kern County, with 11 other companies, including Continental Oil Co. California Research Corp. is conducting a four-well pattern test in Midway-Sunset field near Maricopa, and Richfield Oil Corp. is under way with a test in Ojai field, Ventura County.

● **Fluid dynamics present during underground combustion process** were detailed by L. A. Wilson, R. J. Wygal, D. W. Reed, R. L. Gergins, and J. H. Henderson, Gulf Research & Development Co.

As a combustion zone moves through a formation, the interstitial water, the water of combustion and a portion of the oil will be vaporized. These vapors will move downstream to a cooler region of the formation where they will condense. Part of the remaining oil will be displaced by the imposed gas drive and what remains behind will be consumed as fuel. The

fluids will distribute themselves downstream in a manner which will satisfy the three-phase relative permeability characteristics of the formation.

Three distinct zones will exist ahead of the combustion zone: A zone termed a water bank which contains three mobile phases—oil, water, and gas; a region containing two mobile phases—oil and gas—called the oil bank; and a zone having the fluid saturation distribution which existed prior to combustion.

The mobile water will impose a water flood on the oil in the region containing three flowing phases. The process can be visualized as a simultaneous flood water and combustion-supported gas drive.

• **Gas drives.** The laboratory evaluation of prospective enriched gas drive projects was explained by D. M. Kehn, G. T. Pyndus, and M. H. Gaskell, Humble Oil & Refining Co.

In the past few years, a number of laboratory investigations have been undertaken to increase the recovery of oil from reservoirs by enriched gas drive and solvent flooding. Recoveries from 90 to 100 per cent of the original oil in place have been reported.

Results indicate that recoveries from model reservoirs in the lab are related to the amount of ethane and propane used to enrich the injection gas, and that rate of advance of the gas front should be comparable to field rates in order to avoid premature gas breakthrough.

Further, it is shown that water flooding a sand prior to enriched gas drive does not prevent the recovery of the remaining oil and that the presence of a free gas saturation does not appreciably alter the high recoveries which are characteristic.

The Humble men concluded:

Concentrations of enriching compounds of the order of 40 to 50 per cent by volume in the injection gas are required for these systems in order to effect recoveries above 80 per cent of the oil originally in place.

High water saturation does not prevent the effective displacement of the remaining oil when a sufficiently enriched gas is used as the driving fluid.

The presence of an initial gas saturation in the sand-packed tube does not prevent the attainment of high recoveries of intermediate-gravity oils by repressuring with enriched gas.

With high-gravity oils, substantial recoveries can be effected in the presence of a free gas saturation without repressuring.

High recoveries can be obtained by enriched gas drive whether the oil is originally saturated or undersaturated with gas at the displacement pressure.

• **Improving miscible displacement by gas-water injection** was discussed by H. B. Caudle and A. B. Dyes, Atlantic Refining Co. Miscible displacement recovers all of the oil in the area contacted by the injected fluid, whereas water or immiscible gas drives usually leave substantial amounts of oil as residual. However, the poor mobility ratios associated with a gas-driven miscible displacement cause the sweep pattern efficiency to be much lower than that obtained with water flooding.

One way in which the sweep efficiency in a miscible displacement process can be increased is by decreasing the mobility behind the flooding front. This can be achieved by injecting water along with the gas which drives the miscible slug. This water reduces the relative permeability to gas in this area and thus lowers the total mobility.

The main operating conditions for the simultaneous injection process are that a zone of gas exists between the miscible slug and the leading edge of the water and that a sufficient amount of gas be injected with the water to form the gas volume which is being left in the water zone.

Laboratory model studies have shown that this process is feasible and that the ultimate sweep pattern efficiency can be as high as 90 per cent for a five-spot flooding system.

• **Petroleum vaporization recovery by high-pressure gas injection** was defined by C. L. Barney, Magnolia Petroleum Co., as a pressure maintenance program whereby gas is injected into the oil column of a reservoir under high pressure, resulting in oil production by miscible displacement and absorption.

The vaporization recovery process is a relatively new concept, in oil reservoirs even though a similar process has been used for years in condensate reservoirs. When carried out under proper conditions, the program is expected to yield very high oil recovery.

The recovery method is developed by using an injected gas-reservoir oil phase diagram and certain volumetric balance equations. A volumetric balance of various reservoir fluids is maintained by simultaneously solving sweep efficiency of the respective fluids.

• **Flue gas.** Experiments on miscible displacement or reservoir oil using flue gas were reported by H. A. Koch, Jr., and C. A. Hutchinson, Jr., Atlantic Refining Co.

Their summary: "We have found that under some circumstances flue gas can be used directly to replace hydrocarbon gas to obtain miscibility by the high-pressure gas without significant increase in pressure requirement.

"In other instances where excessive pressure increases may be required to obtain and/or maintain miscibility with flue gas, the flue gas can be employed in an indirect fashion, such as to displace a slug of hydrocarbon gas injected for the high-pressure gas process, to drive a miscible slug, or as a diluent in hydrocarbon gas to obtain a high-pressure-gas type displacement directly."

Completions

• **Engineering steps.** R. W. Coburn, Champlin Oil & Refining Co., reported that field experiments indicate that well stimulation efficiency can be increased by engineering the completion process as an interrelated series of steps. These steps can be selected in a manner that will create conditions most conducive to successful stimulation.

Revision of perforating procedure, and consideration of injection rate per hole as a basis for designing fracture treatments will aid in successfully completing wells at lower cost. Pressure behavior patterns can be translated into efficiency, which in turn can be indicative of the effectiveness of the treatment.

Coburn said communication is a major cause of fracture failure. Communication is defined as the channeling of fluid from the intended path to other points within a zone or well.

Communication can exist in all wells, new or old. Recognition of its occurrence during a treatment is an important tool in the hands of the engineer. Translating the effects of communication into fracture efficiency was accomplished by calculating the per cent efficiency from a simple formula.

$$\text{Apparent efficiency (\%)} = \frac{\text{Number of stages} \times \text{injection rate}}{\text{Number of perforations} \times \text{injection rate per hole}} \times 100$$

By plotting pressure against per cent of holes fractured, pressure increases and decreases can be graphically shown. Subtraction of the percentage covered by constant or declining pressure from apparent efficiency yields the actual fracture efficiency.

Some concluding points offered by Coburn:

1. Ball sealers are effective sealers for casing perforations.
2. Crushed moth balls are effective in plugging the formation.
3. Pressure behavior during a stage treatment can be used to recognize the occurrence of communication.
4. Treatment efficiency can be used to determine the effectiveness of a treatment.
5. Reduced perforation density aids in increasing well completion efficiency at reduced costs.

• **Hydraulic fracturing.** "Fracture Flow Capacity vs. Well Productivity?" was analyzed by H. K. van Poollen, John M. Tinsley, and Calvin D. Saunders, Halliburton Oil Well Cementing Co. General results of the studies indicate the results of a fracturing treatment are very dependent upon the flow capacity of the produced fracture. Any method which causes a flow restriction in the fracture can reduce the possible production increase.

The Halliburton experts said that restriction of flow through a propped fracture can be caused in part by:

1. Overflush. Removal of propping agent by overflush from the close proximity of the well bore may allow excessive "healing" or closing of the fracture in this area.
2. Premature production after treatment. This can also cause removal of propping agent leaving conditions similar to overflush.
3. Release of formation fines from fracture surfaces. Such fines can become integrated within the propping agent thus reducing the effective permeability. Even small percentages can be very detrimental.
4. Fluid effect on competency and strength. Use of an improper fracturing fluid and/or other fluids in conjunction with the treatment can cause partial to complete disintegration of some fracture surfaces thus releasing fines, silts, and clays.

Productivity increases may be improved by the following:

1. Large propping agent. The use of as large a propping agent as practical for the particular well conditions should give superior results.
2. "Tail-in." If sufficiently large sand cannot be used throughout, the use of a large sand at the end of the treatment can be very beneficial.

One blowout and $800,000 later . . .

Panhandle Test Hits Good Pay

CANADIAN, Tex.—Parker Petroleum Co., Inc., has cautiously completed its wild high-pressure discovery in the Texas Panhandle, after nearly a year of costly dual-well drilling, a blowout, and cratering trouble.

The 1-A Ben Hill in Roberts County found nearly 92 ft. of good pay and tested gas and high-gravity oil in both the upper and lower Morrow sands.

The well made 23,000 M.c.f. of gas per day and 79 bbl. of 55½°-gravity oil per million cubic feet from lower Morrow perforations at 10,906-28 ft. The open-flow test was through ½-in. choke. The lower Morrow was the well's original "blowout" sand.

Upper Morrow perforations at 9,832-51 ft. tested 7,600 M.c.f. of gas with 3 bbl. of 50°-gravity oil per million cubic feet, through various-size chokes. Only 41 ft. of the 92-ft. pay zones were perforated.

Bottom-hole pressure in the lower zone was 7,150 psi. and surface pressure was 4,489 psi. In the upper zone, bottom-hole pressure was 5,175 psi. and surface pressure 3,390 psi.

The well is northwest of here and about 12 miles east of Morrow gas production at Lips pool (see map).

Drill-stem tests, which started in September, were halted after high pressure and the rate of flow made the "flow so wild we got scared and shut it in," Orville H. Parker, president of the Ponca City, Okla., firm, said. Special testing equipment was moved onto the site earlier this month.

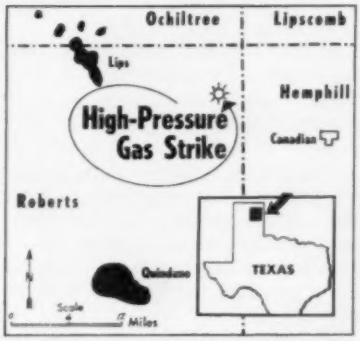
Trouble . . . Parker has had a heap of trouble since the first of two wells was staked last November on the 2,560-acre block. Sun Oil Co. supported the original operation.

In January, the well blew out at 10,924 ft. and flowed uncontrolled for several weeks. After killing the well Parker tried to sidetrack and redrill.

Meantime, Sun started its own well about ½ mile west of the Parker site. This well was completed for about 8,000 M.c.f. of gas daily from a sand lens in the lower Morrow.

Parker continued redrilling the tamed well, but 4 months after the blowout, the well cratered while drilling at 6,253 ft. The rig was saved but the drill pipe was lost. The company jacked the rig out and skidded it 600 ft. northeast of the trouble spot. The new hole—the 1-A Ben Hill—was started in May.

The operation has cost Parker more than $800,000. About $540,000 of this was lost through the blowout and subsequent cratering. The mud and weight bill was more than $150,000. More than 40,000 sacks of cement was used to fight the blowout.



California Driller Quits

BAKERSFIELD. — A California drilling contractor is quitting the business, claiming cut-throat bidding practices have forced his move.

Gene Reid Drilling, Inc., a leading contractor in San Joaquin Valley, announced it is quitting after 15 years in the business.

"It has been a matter of deep concern to us that contract income under present bidding does not provide the corporation with a satisfactory return, considering both variable and fixed costs," Gene Reid, president of the company, said in announcing the decision to liquidate.

Company assets include five drilling rigs and 200 bbl. daily production from several San Joaquin Valley oil fields.

Suntide Refining Sale Off

BIRMINGHAM, Ala.—Southern Natural Gas Co. has called off its purchase of Suntide Refining Co.'s 75,000-bbl. refinery at Corpus Christi.

C. P. Rather, Southern Natural president, said the deal was killed when a "complicated situation" that could not be overcome developed during negotiations. Southern Natural announced in May plans to buy the plant. (OGJ, May 13, p. 84).

Rather said killing the Suntide deal does not alter Southern Natural's plans to diversify. The Birmingham company operates more than 3,800 miles of gas lines in the south and southeast, but wants to expand into other petroleum fields.

Headlee Job Launched

Injecting gas at high pressures is expected to recover an estimated 50 million barrels of additional crude oil

MIDLAND, Tex.—Operators in the big Headlee Devonian field of West Texas finally are starting a high-pressure gas-injection project in a race to save 50 million barrels of oil.

Last red-tape barrier to the project was broken last week. The Texas Railroad Commission approved Texas Gulf Producing Co.'s plans for a Headlee Devonian unit. Initial plans for a gas-drive project also were approved.

At the same time Texas Gulf Producing, operator of the unit, revealed the program for Headlee Devonian unit included:

. . . **A quick start** of gas injection on a small scale by next month but slow development of the full program.

. . . **Future expansion** of the unitized area. Prospects were considered good that other nearby fields would join the project.

Unusual quirk . . . The Headlee unit may go down as one of the most interesting secondary-recovery programs yet conceived.

Texas Gulf Producing will inject gas at a high input pressure of at least 5,500 psi. This, as high pressures go, is second only to the 6,500 psi. maintained by Sunray Mid-Continent Oil Co. at its Northwest Branch field project in Louisiana.

But more strange is this: Headlee is one of few fields where operators actually sought cuts in their oil allowables. They asked for an 80 per cent reduction or only 3 producing days a month. The object was to keep reservoir pressure from falling below the saturation point before the unitized project could stabilize pressure.

The commission compromised on a 6-day producing schedule for the field. The 6-day schedule has been in effect since November 1, 1956.

Room for growth . . . The Headlee unit, as approved last week, takes in 8,391 of 12,840 estimated productive acres in the field.

But the commission authorized the unit to take in more tracts as other operators, who have hung back pending the approval, express willingness to join.

Some already have done so. The unit operating committee already is holding meetings to extend the unit bounds to take in another 2,000 acres. This will boost unit size to more than 10,000 acres and make it one of the larger programs in West Texas. Still more acreage likely will be added.

The commission, following Texas Gulf Producing proposals, extended the field boundary further south by transferring to Headlee four sections formerly classed as being in Dora Roberts field. It fixed the south boundary of the Headlee unit at the north boundary of the Dora Roberts ranch.

How it works . . . Texas Gulf Producing plans to get the injection program off to a quick start but to develop it slowly on a 320-acre, nine-spot pattern over about a 4 to 5-year period.

Injection will be kicked off late in November with three inputs, now producers belonging to Tidewater Oil Co. The gas will be purchased from the Headlee natural-gasoline plant and injected at a rate of 800,000 to 2,000,000 cu. ft. daily into the 11,800-ft. Devonian formation.

Compressors capable of injecting at pressures up to 7,500 psi. are on order and are expected to be delivered the last of this month.

The Devonian in Headlee is extremely tight—so tight that some minority interests opposing the project argued that gas injection couldn't succeed. Bulk of the working interest, however, has little doubt of its success.

A Texas Gulf Producing spokesman told the Journal last week it is quite possible that input pressures may go no higher than 5,500 psi. This is partial reason, he said, for buying compressors with so much apparent excess capacity.

At any rate, Texas Gulf Producing hopes to complete the first phase of project development by the second quarter of next year. By then it expects to have eight injection wells in operation.

A time table for subsequent development hasn't yet been set up.

Coming out ahead . . . The far-sighted Headlee operators will reap a large reward in years ahead for the production pinch they have endured the past year.

They estimate that the injection program will increase ultimate recovery from the 200-ft.-thick Devonian pay to a total of 82,824,829 bbl. of the 152,288,820 bbl. estimated to have been in the lime originally.

This stacks up with an estimated 19,868,619 bbl. recoverable by primary means which roughly figures out to a meager 1,540 bbl. per acre.

Such a per acre recovery likely would have done little more than get the operator back his investment in Headlee, if that.

High-pressure gas injection, Texas Gulf Producing estimates, will reduce Headlee Devonian's residual oil saturation to only 19 per cent of pore space.

Neighbor unit coming . . . The big Headlee unit soon will be joined by a neighbor unit only slightly smaller.

Operators in Dora Roberts Devonian are well along with unit negotiations including signing of agreements by working and royalty-interest owners.

This is hardly surprising since Headlee and Dora Roberts are recognized by both the commission and operators in each field as being a common reservoir. Thus, Dora Roberts faces a situation similar to that Headlee faced a few months back.

Informed sources say the upcoming Dora Roberts project will be quite similar to that in Headlee. It, too, will go to the high-pressure gas-injection route.

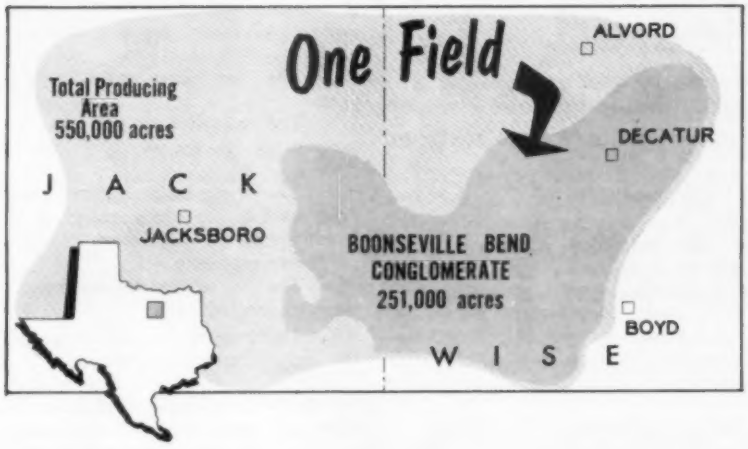
Pipeline Files Damage Suit

NEW ORLEANS.—Texas Eastern Transmission Corp. last week slapped a $32,235,000 damage suit on barge and oil operators for alleged illegal hamstringing for months of its effort to convert the Little Big Inch pipeline from gas to products service.

Texas Eastern said in its complaint filed with the U.S. District Court here that a planned campaign of harassment by three oil companies, nine barging firms, and one individual cost the company $10,745,000 due to delayed operation.

The civil damage suit charges that the defendants violated the Sherman and Clayton antitrust acts. And the law, it says, entitles Texas Eastern to recover triple damages.

Defendants named in the complaint are: Ashland Oil & Refining Co.; Ingram Products Co., Inc.; Martin Oil Co.; Comet River Co.; Chotin Towing Corp.; G. W. Gladders Towing Co., Inc.; Greenville Towing Co., Inc.; Walter G. Houghland Sons, Inc.; Industrial Marine Service, Inc.; Ingram Barge Co.; Lea River Lines, Inc.; River Co., Inc.; and Harry Baker Jordan, New Orleans.



Consolidation ends long hassle:

Jack, Wise Gas Fields Merged

AUSTIN.—A giant new gas field sprawling over 251,000 acres in Jack and Wise counties in North Central Texas was born last week by order of the Texas Railroad Commission.

The commission ordered 29 fields with 220 wells producing from the Bend comglomerate merged. The new field is named Boonseville Bend conglomerate after the biggest of the combined pools.

Lone Star Gas Co. had sought consolidation of an area twice as big—550,000 acres stretching 35 to 40 miles long and 20 to 25 miles wide and including 81 fields. But it failed to present evidence of pay interconnection outside the 251,000 acres affected by the order.

Christie, Mitchell & Mitchell and others had fought the Lone Star proposal in a long series of hearings dating back to May 20 (OGJ, May 27, p. 96; Aug. 19, p. 100; and Sept. 30, p. 64).

The commission feels its order will further ratable take and correct inequities growing out of special rules in effect at the various fields involved.

New rules for the big field call for 467 to 2,000-ft. well spacing; 320-acre proration units with 10 per cent tolerance and a maximum diagonal of 4,000 ft.; allocation based on reservoir pressure times acreage; and field allowables based on purchaser nominations unless actual production indicates another demand figure.

Merging pools include the Boonesville Atoka conglomerate; the 4,900-ft. Atoka conglomerate; 5,000-ft. Atoka; 5,600-ft. Atoka conglomerate; Bridges conglomerate; Cottondale 5,300-ft. conglomerate; Cottondale East Atoka conglomerate; Cottondale South 5,700-ft. conglomerate; Bridgeport Atoka conglomerate; Caddo conglomerate; Cherryhomes conglomerate; Daly Atoka; Decatur Atoka conglomerate; Decatur North; Dees 5,500-ft. conglomerate; Henry; Jack County Regular conglomerate and Atoka; Jopline Bend; Jupiter conglomerate; Rusmag conglomerate; Vineyard; Wizard Wells Atoka; and Worsham-Steed Heath Bend conglomerate.

Another Miscible Job Starts

WICHITA FALLS, Tex.—Cities Service Oil Co. has launched its second miscible-phase displacement project in Texas. It's a small 26-acre test in Wilbarger County Regular field in North Texas.

The company will inject 20,000 bbl. of propane into the 1,100-ft. sand through two wells on its Gussman-Waggoner "G" lease. This will be followed with 5,000 M.c.f. slugs of separator gas injected at the rate of 112 M.c.f. daily.

Cities Service engineers estimate the miscible program will increase recovery by 85,000 bbl. over primary methods and 35,000 bbl. above what could be taken by water flooding. Residual-oil saturation, they say, will be cut from 41.3 per cent to 17 per cent by the project. Water is being injected through a third input to set up a water block and prevent oil and product drainage to other leases.

Meanwhile, The Texas Co. obtained a permit to switch from gas injection to a miscible program in Tijerina Zone 3 of Tijerina-Canales-Blucher field in Jim Wells County, South Texas.

—— *Industry* briefs

Oklahoma's deepest well, the 1 Sterba of Magnolia Petroleum Co. in Caddo County, has tested successfully a pay formation after plugging back to the Springer sand. The well, drilled to 20,426 ft., flowed gas at the rate of 1,865 M.c.f. daily from perforations at 14,415-19 ft. Condensate flowed 8 bbl. in 2 hours.

After failing to find oil at the record depth, operators plugged back to 14,455 ft. During the drill-stem test gas flowed in 70 minutes. When pipe was pulled after the test, distillate was recovered in 3,000 ft. of pipe.

American Trading & Production Corp. last week bought five Devonian wells and an estimated net 500,000 bbl. of crude reserves in Gladiola pool of Lea County, New Mexico. The deal was made with Texas Crude Oil Co., Fort Worth. Consideration was not disclosed.

Western Reserve Corp., Dallas, has bought interest in 31 oil wells, 4 gas wells, and about 12,500 acres of undeveloped properties. The deal with Service Drilling Co., Tulsa, and Ted F. Dunham, Baton Rouge, La., involved about $750,000. The producing wells are in Osage and Washington counties, Oklahoma, and Hutchinson County, Texas. The undeveloped leases are in the Rocky Mountains, New Mexico, and Oklahoma.

Slick Secondary Recovery Corp. of San Antonio has added 720 acres to its holdings in Lopez field of Webb County, Texas, and is getting ready for a large-scale water flood there. The firm acquired the acreage from Superior Oil Co. The deal included 25 wells producing approximately 75 bbl. daily from around 2,200 ft. Slick already owned 107 producing wells in the field.

The Magic Plains Oil Exposition at Borger, Tex., has been moved back to November 14-16 because of a delay in construction of the show's $125,000 aluminum-dome exhibition hall. It was originally scheduled for October 17-19. Some 65 exhibits have been signed for the show.

Oxford & Stasney Drilling Co. of Albany, Tex., has sold its two rotary rigs to Empire Drilling Co. of Dallas. The rigs were moved to Andrews County, Texas. Partners in the firm were Robert W. Oxford and H. R. Stasney. Stasney will still keep an office in Albany for his oil operations.

Compact Is Cleared

But Attorney General says agency should find out whether big companies are stifling competition for crude supplies

WASHINGTON. — Lack of full, free competition in the oil industry may be sapping the strength of the Interstate Oil Compact Commission, Atty. Gen. Herbert Brownell, Jr., believes.

The compact itself is doing a good job. But it needs to study further the ways by which the major integrated companies may be undermining the compact's conservation efforts, Brownell told Congress in his annual report.

"The outline of the industry, indistinctly revealed by preliminary analysis, does suggest doubt as to the degree of competition in the crude oil supply industry," the attorney general said.

The inquiry could be furthered by legislation which the Justice Department has requested, Brownell suggested. This would allow the department to call on companies to open up their files.

Brownell's report was the second of four which Congress directed him in 1955 to make at 12-month intervals. The aim of the reports is to show whether the activities of the states under the compact lead to monopoly or price-fixing.

"On the whole, the activity of the commission appears to have been worth while," this year's report stated.

The report credited the compact's promotional activities with improving the industry's operations over the last quarter century by eliminating gushing wells and flaring gas, using reservoir energy better, and boosting oil production from about 20-40 per cent to 80 per cent of a well's potential through advanced recovery practices.

"Above all," said the report, "the compact and its commission are unique examples of effective interstate cooperation on a wholly voluntary basis."

Allowable policies . . . The report said charges that state production allowables are tied rigidly to the U. S. Bureau of Mines' forecasts are unfounded.

The study also indicated that market-demand laws are not necessarily a controlling factor in restricting production if the results are averaged out over a period of years, nor is there a close parallel action among the compact states on production policies.

Instead, other factors may be of greater importance in fixing production.

"The possibility is also suggested that the policies of the petroleum purchasers, who operate generally in all these states, may have a greater influence on approximating production to market demand than do the state regulatory agencies," the report said.

The recommendations . . . While giving the compact itself a clean bill of health, the Justice Department cited several areas in which studies should be made of the oil industry. They include:

. . . The competitive role of posted prices.

. . . The influence of swap-out arrangements on the level of posted prices.

. . . The undesirable control over field markets for crude exercised by large integrated purchasers through purchaser proration.

. . . The competitive disadvantage of the unconnected wells

. . . The control over crude supply through ownership of pipelines.

The report said there is a "disparity of economic power" between the integrated purchaser and independent producer, and this condition has "potential anticompetitive implications."

Eight 100,000-Ton Tankers

. . . ordered by Ludwig, Onassis, Niarchos for construction at Kure and Quincy. They'll be the world's biggest ships

FIVE GIANT TANKERS of more than 100,000 deadweight tons—bigger than anything afloat—have been ordered by National Bulk Carriers for construction at its leased shipyards at Kure, Japan.

Three other tankers of similar size have been ordered for construction in the Bethlehem yards at Quincy, Mass. Two are for Victory Carriers, an Aristotle S. Onassis company, and one is for Manhattan Tanker Co., a Stavros S. Niarchos company.

When the first of the new ships is completed, it will be, by far, the largest vessel in the world. The Queen Mary, the Queen Elizabeth, and the United States will exceed it in length, but the tanker will be much wider and have far greater cargo capacity.

National Bulk Carriers, the firm headed by Daniel K. Ludwig, has announced it plans to lay the keel for the first of its five ships at Kure on June 1, 1958, and complete it before December 31. The company has leased the Kure shipyards through 1966.

The company says the tankers will have a capacity of 750,000 bbl., will be about 900 ft. long and 135 ft. wide, and have a tonnage of 103,000. They will be powered by 27,500-hp. steam turbines and have a top speed of about 16 knots. Their huge size and draft will prevent them from using either the Suez or Panama canals.

The Quincy ships . . . The three tankers to be built in the U. S. at Quincy will be slightly larger. They will have a tonnage of 106,500 and carry about 825,000 bbl., almost six times as much as the famed World War II T-2 tanker. They will be about 940 ft. long and 132 ft. wide, and draw 47 ft. Their draft will permit them to serve Marcus Hook and a number of West Coast terminals.

Turbines on the three twin-screw Quincy vessels will develop 43,000 shaft hp. They will do 17½ knots and have a crusing radius of 26,000 miles, enough to take them around the world on a single fueling.

Keel for the first of the Quincy trio will be laid in 1958, and delivery is set for late 1959 or early 1960, well after the completion date set for the first ship at Kure.

Other plans . . . Ludwig also is reported building six other big tankers at Kure. They will have 85,515 tons and will be in the same class as the Universe Leader, now the world's largest tanker at 84,730 tons. Universe Tankships, another Ludwig subsidiary, started construction of two of the six in April and May.

Two smaller tankers of 45,450 tons also are in the building program of Universe Tankships.

Meanwhile, Barber Oil Co.'s subsidiary, Hercules - Liberia Corp., announced plans to order three 46,000-ton ships, each to cost $13,750,000. The ships will be built at Quincy and fly the Liberian flag.

Gulf Oil Corp. early this month accepted the second of 10 new tankers

it has ordered as part of a $114-million fleet expansion program. The ships are being built at Bethlehem's yards at Sparrow's Point, Md. Four will be 32,650-ton vessels and six 29,250 tons.

The ship accepted by Gulf, christened the Gulfqueen, is a 32,650-tonner, has a capacity of 230,000 bbl., is 661 ft. long and 90 ft. wide, and draws 34 ft.

Allowable Test Set

Gulf cited for contempt by Oklahoma commission

A FULL-SCALE COURT TEST is in the making to determine whether states have the authority to force oil purchasers to take their full production allowables.

The stage was set last week when the Oklahoma Corporation Commission cited Gulf Oil Corp. for contempt.

Gulf prorated its August runs 20 per cent below those of July in Oklahoma and also cut below allowables in other states. The Oklahoma regulatory body, unlike other states, specifically requires crude buyers to take the full amount of oil allowed unless otherwise authorized by the commission. The courts have never ruled on the constitutionality of such a requirement.

Gulf earlier went into federal court on the issue, but the U. S. Supreme Court ruled the company had failed to exhaust its rights in the Oklahoma courts and refused to accept jurisdiction in the case.

After the U. S. court's decision, neither side made a move until the commission last week took action. The commission directed Gulf to appear at a hearing November 27 and 29 "to show cause why it should not be punished or why other appropriate enforcement orders should not be entered against it."

Should the commission stand firm and hold Gulf guilty of contempt, the oil company is expected to appeal the ruling through the state and federal courts.

Gulf buys about 40,000 bbl. of oil daily in Oklahoma, half of it directly and the other half from other primary purchases through reciprocal repurchase agreements, according to the commission citation.

The commission said Gulf has committed "in excess of 100,000 separate offenses and violations of commission orders." The large number results from the fact that proration for each lease affected constitutes a violation for each of the 30 days in August.

Pipeline briefs

Lakehead Pipe Line Co., Inc., will increase throughput from 212,000 to 234,400 bbl. per day with the addition of a booster station near Gould City, Mich. The 4,300-hp. station, which has room for another 1,750-hp. unit when needed, will be completed next June. The station will cost $800,000 to $900,000, and will be remote controlled from Superior, Wis. It will be the eighteenth station on the 1,931-mile Interprovincial Pipe Line Co. and Lakehead system from Edmonton to Toronto.

El Paso Natural Gas Co. has bought one-half interest in a 10,400-acre block in the Texas Panhandle. The block contains four gas wells and has reserves estimated at about 72,000,000 M.c.f. of gas. El Paso is building a gathering system and trunk line from the area. Lines will range up to 20 in. in diameter.

Tecumseh Pipe Line Co.'s new 201-mile, 20-in. line from Griffith, Ind., to Cygnet, Ohio, is being tested. Some backfilling and cleanup work also remains on the crude system, owned by Sinclair Pipe Line Co., Ashland Oil & Refining Co., and Pure Oil Co. Station work is still in progress. The pipeline, with one station at Hartsdale, Ind., will have initial capacity of 100,000 bbl. daily going to Ohio, Michigan, and New York refineries.

Texas Eastern Transmission Corp. has almost completed a $29,000,000 expansion program just approved by a Federal Power Commission examiner. Construction has gone ahead under temporary authority granted in June. The project involves 96.5 miles of 30-in. loop between Kosciusko, Miss., and Uniontown, Pa.; 9 miles of supply laterals; a 10,250-hp. compressor station; and 33,360-hp. added to present stations.

The affiliated Texas Eastern Penn-Jersey Transmission Corp. has added 24,000 hp. to its system. The expansion will permit sale of an additional 128,217,000 cu. ft. daily of long-term firm gas and 92,644,000 cu. ft. of winter peaking gas.

Trans-Canada Pipe Lines, Ltd., and Northern Ontario Pipe Line Crown Corp. are making rapid progress extending the gas line eastward from Winnipeg toward Montreal. The Northern Ontario section will complete two phases of its project within the next 2 weeks. One is 94 miles of 30-in. between Kenora and Dryden, and the other is a 30-in. crossing of the Eagle River. Both jobs were contracted to Western Pipe Line, Inc.

Trans-Canada completed a 20-in. crossing of the Trent River last week. The crossing was laid by Marine Pipeline & Dredging, Ltd. An 84-mile, 20 and 24-in. spread between Toronto and Whitby, Ont., will be finished by the end of the month. Oklahoma Pipe Line Constructors is laying this section.

Interprovincial Pipe Line Co. has started deliveries to the British American Oil Co., Ltd., refinery at Clarkson, near Toronto. The deliveries started with the completion of a 40,000-bbl. crude unit at the plant, which previously had capacity of 21,500 bbl. per day. Before Interprovincial built its 156-mile, 20-in. line from Sarnia to Toronto, crude was shipped from Superior by tanker. The pipeline connections reduces the need for crude storage during the winter when navigation halts. Deliveries are scheduled to start November 1 to Regent (Refining) Canada, Ltd.

Rangeland Pipeline Co. plans to start taking oil from Innisfail D3 field within 2 weeks. A 19-mile, 8-in. spur now being completed from the Rangeland system is contracted to Hutchinson Construction Co. of Leduc. The project cost $270,000. It will give the field a connection with the Interprovincial and Trans Mountain systems at Edmonton.

Also for Pipeliners . . .

IN THE NEWS: Shell plans crude line to tie Louisiana Delta area to its refinery at Norco (p. 107) . . . Katy and New York Central railroads study plans for an L.P.G. pipeline from Houston to the East and Midwest along their rights-of-way (p. 110) . . . FPC examiner recommends package deal involving five pipelines that will give the Chicago area 485,000 M.c.f. daily more gas (p. 111) . . . Texas Eastern files $32-million suit against barge and oil operators (p. 116).

PLUS THESE TECHNICAL REPORTS: How Continental Pipe Line cleaned up a 100-mile crude line for conversion to products (p. 219) . . . and Pipeline Patrol's construction report (p. 229).

Qum Outlet Planned

● Big line across Turkey to Mediterranean backed by Shah of Iran, New York banking interests; final decision to build hinges on proved reserves in Alborz field

THE SHAH OF IRAN last week took some of the wraps off a whopping $450 to $500-million deal for a pipeline to the Mediterranean.

He told the opening session of the Iranian senate that his government soon would ask parliament for permission to sign a pipeline agreement with an American company. The 1,000-mile line would carry crude from Alborz field in Central Iran to Iskenderun, Turkey.

The project hinges on proving Middle East class reserves in the Qum area. But if reserves live up to promise, the line will be a big one, possibly moving 400,000 to 600,000 bbl. daily or more.

Allen & Co., New York investment bankers, confirmed that they are behind the project. Martin Carton, negotiator for the firm with the Iranian Government, described the over-all proposal to The Oil and Gas Journal on his return to New York.

Details and the name of the company formed to handle financial arrangements will be made public after the bill goes to parliament.

The Allen proposal has the jump on another proposed line backed by two American oil companies not active in Iran. The two U. S. firms have been dickering with Iran, hoping to land a concession in the Qum area and build the line as part of the deal.

Ownership . . . Allen & Co. interests will have controlling interest in the line. These interests will be purely financial, but will control both construction and operation.

The project is comparable to pipeline companies set up in recent years in the United States and Canada. The founding group initially has a large interest, some of which is parceled out later.

No oil company is at present involved, neither independents nor any of the international majors.

There is no definite financial arrangement as yet with the Iranian Government on profits. This remains to be worked out later.

Iran will own the section of line as far as its frontier. The new company will own the section in Turkey. But the entire line will be managed as a unit.

The eventual stock ownership is not yet worked out. Part ownership could be public, for instance, and part could be owned by a refining company.

Marketing . . . There are no plans at present for marketing the oil. If reserves are proven, outlets will be sought.

There is definitely no intention to battle the international companies for markets. The new company hopes to make the best deal possible for selling the oil. It is willing to make a long-term deal with one of the major companies, if Iran agrees.

Construction . . . From 1½ to 2 years will be needed to determine whether there are sufficient reserves. The size of the line would hinge on the productive capacity of Alborz and perhaps one or two other structures.

An additional 18 months or so would be needed to build the line and line up markets. The line would be built and operated by a company to be set up later.

One technical problem is caused by the high paraffin content of Alborz crude. There has been no experience in moving this type oil through big-inch trunk lines. But a special engineering study indicates this problem can be overcome at reasonable cost.

Other developments . . . The Shah's pipeline plan paced several other Iranian developments:

. . . The second Alborz stepout will spud this month. It will go a long way in defining the field.

. . . Three Italian survey teams will start preliminary work next month. They will study E.N.I. blocks in the Gulf of Oman, Continental Shelf, and Zagros Mountains.

. . . A 70-mile, 8-in. natural-gas line from Agha Jari field is definitely in the works. It will supply feed stocks to a petrochemical plant to be built at Ahwaz under the government's industrial development program.

National Iranian Oil Co. expects to come up with a fairly good answer to Alborz when it completes six stepouts in its current program. Wells will be started every 5 months. The second in the series is about to start.

The first stepout, spudded in March 1½ miles from the discovery, found traces of gas and oil at 9,882 ft. and is drilling ahead. The discovery blew out late in 1955 at 7,800 ft.

Pure Gets Big Paraguay Grant

PARAGUAY, one of the few Latin American countries without oil production, is banking on Pure Oil Co., Chicago, to take it out of that class.

Gen. Alfredo Stroessner, president of Paraguay, has confirmed earlier reports that Pure is being granted a concession (OGJ, Oct. 7, p. 122). He said Pure's grant will initially cover 14,500,000 acres in the Chaco Boreal region bordering productive areas in both Argentina and Bolivia.

Pure officials said the contract calls for two wells—the first to start within 8 months. If results are good and the company wants to retain maximum acreage, it must undertake an extensive exploration and drilling program. The contract has yet to be ratified by the Paraguayan congress.

President Stroessner said Pure will put up $1,500,000 within 30 days after signing the terms already agreed upon. The firm agrees to spend another $500,000 within 20 months.

Williams Brothers Sudamericana, Inc., subsidiary of the Tulsa pipeline construction firm, has 50 per cent interest in the concession. Williams Brothers is also interested in a nearby Bolivian concession with Gulf Oil Corp., Falcon Seaboard Drilling Co., and Barry & Reiner, Inc., Tulsa. This block includes 3,750,000 acres.

Pure and Williams Brothers will pay Paraguay 1¼ cents per acre rental for each of the first 4 years, or about $720,000. The acreage will shrink according to an agreed schedule until at the end of the first 14 years Pure will hold only 1,800,000 acres. This will be divided into blocks of 12,000 acres, and Pure will be given the option to choose which blocks it wants to develop.

The agreement assures Paraguay 11 per cent of the gross output plus 30 per cent income tax on Pure's profits. Term of the concession is 40 years.

Paria Drilling Set

Combine forms new firm to test high-priced area

THE FIRST WILDCAT to test Venezuelan waters in the Gulf of Paria will be drilled the middle of this month by a new company formed last week to operate 152,000 acres in concessions offshore.

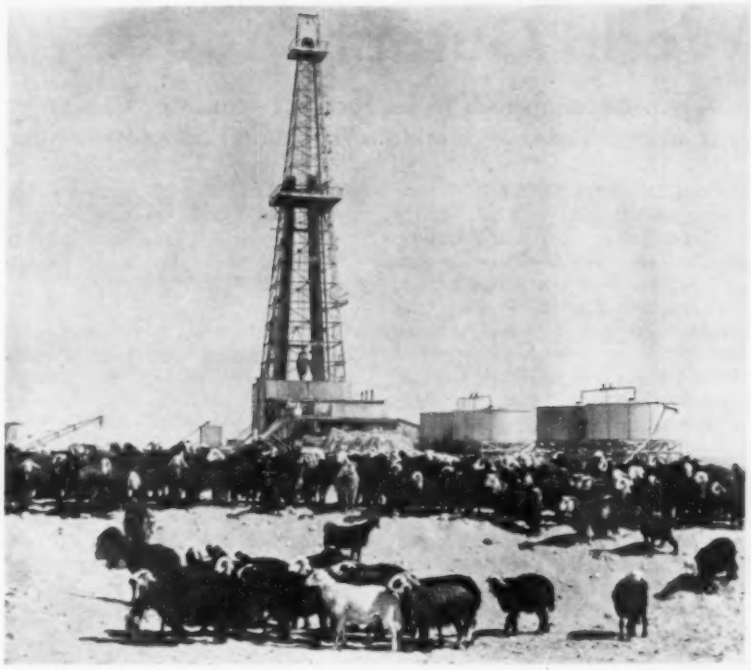
The company, Paria Operations, Inc., is headed by T. A. van Griethuysen, president of Continental Oil Co. of Venezuela. The operating company is owned by Conoco, The Texas Co., and Ohio Oil Co., each holding 25 per cent, and Cities Service Co., with 16⅔ per cent, and Richfield Oil Corp., 8⅓ per cent.

The five companies lumped bids for $100 million to obtain the acreage between Trinidad and Venezuela's northeast coast.

The first test will be drilled 6 miles offshore in 90 ft. of water from a platform served by a Loffland Brothers Co. drilling tender. The site is about 10 miles from offshore production in Trinidad's Soldado field.

Three more platforms already have been built and are being spotted on other concessions within the five-company combine's acreage.

Other officers of the newly organized operating company are R. E. Wright, Texas Petroleum Co., executive vice president; B. F. Wright, Texas Petroleum, and G. R. Harsh, Cities Service, vice president; F. K. Foster, Cities Service, secretary-treasurer, and M. B. Saul, Ohio Oil, assistant secretary-treasurer.



Wildcat Joins Herd in Saudi Interior

ARABIAN AMERICAN Oil Co.'s heavy drilling rig in Central Saudi Arabia is a curiosity to the local livestock.

This herd of goats isn't the slightest bit afraid of the rig's towering mast and noisy machinery. They're attracted by the water trough provided at the well location by Aramco.

The rank wildcat at Khurais was drilling below 3,956 ft. last week. The company is trying to evaluate the central interior of its concession. The well is 75 miles west of the center of Ghawar field and about 170 miles southwest of Abqaiq.

The company plans to penetrate and test the equivalent of all the oil-bearing formations in the coastal region of the country. This rig is the one which drilled Aramco's 14,875-ft. dry hole in the Rub-al-Khali Desert

Persian Gulf Test Spudded

THE "QUEEN MARY," Arabian American Oil Co.'s drilling barge which established the world's biggest offshore oil field, is trying to do it again, this time on another Persian Gulf wildcat.

The barge is drilling a new test on the Manifa structure, 9 miles off Saudi Arabia, in the Persian Gulf. The test, long in Aramco's drilling plans, is about 20 miles from the southern end of Safaniya field, the Middle East's only producing underwater field.

The Queen Mary was pulled away from Safaniya and moved south after setting a new drilling record of 20 days and 21 hours completing Safaniya 27 at 5,480 ft.

The new structure is in Manifa Bay, about halfway between Safaniya and the company's new wildcat success Khursaniyah, which is on land.

Conorada Asks Tunisian Rights

CONORADA PETROLEUM CORP. has applied for a 28,000-sq. km. exploration concession in west-central Tunisia.

Private sources in Tunis expect the concession to be granted. If there is no hitch in the final negotiations, Conorada will be the first American oil company to enter Tunisia since it became independent last year. The firm is owned by Continental Oil Co., Amerada Petroleum Corp., and Ohio Oil Co.

The only company now active in Tunisia is Ste. de Recherches et d'Exploition des Petroles en Tunisie (S.E.R.E.P.T.). This is a joint government company owned 70 per cent by the French and 30 per cent by Tunisia.

S.E.R.E.P.T. has concessions in the country of 74,688 sq. kilometers. The largest single block is in the southeastern part of the country and extends just north of the harbor at Gabes. The area sought by Conorada is to the west of Gabes and extends to the Tunisian-Algerian border.

Until 1954, Gulf Oil Corp. carried on a Tunisian exploratory program through Ste. Nord Africaine des Petroles (S.N.A.P.) in which it held 65 per cent along with S.E.R.E.P.T. Gulf abandoned its search and gave up five acres after it drilled five dry holes ranging from 3,900 to 12,053 ft.

The only production found in Tunisia was a small natural-gas field at Cap Bon in the northern tip of country. Gas from this field is moved through a 4-in., 40-mile pipeline to Tunis where it furnishes the capital's gas requirements.

World Output Drops

July production fails to set record because of decline in U. S. and Venezuela; Middle East chalks up another gain

PRODUCTION DECLINES in the United States and Venezuela during July reversed a trend which had established free world production records for 5 consecutive months.

Except for Kuwait, Persian Gulf output continued to mount during July.

But for the free world as a whole, production was off 291,400 bbl. daily in July, compared with June. The United States was down 234,000 and Venezuela 91,100. In the free world outside the U. S., the decline amounted to 57,400.

Not since last November has production in the free world been less than the preceding month; and not since February has it failed to set an all-time record.

The Western Hemisphere lag changed the picture. Domestic output dropped from 7,107,000 bbl. daily to 6,873,000, while Venezuela sagged from 2,968,600 to 2,877,500.

Middle East gains . . . Three Persian Gulf countries — Iran, Saudi Arabia and Qatar—set records. But Kuwait declined by 82,000 bbl. daily to 1,288,000. Over-all gain for the Middle East was 32,100.

Iranian Oil Exploration & Producing Co., operator for the consortium group, set an all-time high of 756,000 bbl. daily. It also completed the best 6-month period in Iran's history. The February-July level was 701,000, not including 4,000 produced by the government company outside the consortium area. The best previous 6 months was March - August 1950, when the country's total production was 686,000.

Saudi Arabia output reached a record production of 1,209,800 bbl. daily, raising the February-July average to 940,000. Qatar had its best month in history at 158,700.

New French production . . . The French without fanfare have started commercial production in the Gabon area of French Equatorial Africa.

Ste. des Petroles d'Afrique Equatoriale Francaise, controlled by the French Government, began lifting crude in February from Pointe Clairette and Ozouri fields. The initial offtake was 800 bbl. daily, increasing to 2,100 in March, 2,600 in April, and 3,600 bbl. in May.

The fields were discovered within the past 2 years on Pointe Clairette Peninsula extending into the Atlantic Ocean. Production of 22°-gravity crude is from shallow salt dome structures. The fields lie 20 miles apart and are conviently near an established port, Port Gentil. Crude is shipped to France for refining.

In India, Assam Oil Co., the only company with commercial production, is producing 8,500 bbl. daily from Digboi and Nahorkatiya fields.

The 67-year-old Digboi averaged 5,000 bbl. daily. Nahorkatiya produces 3,500 bbl. daily from three flowing wells. Nos. 1, 2, and 8. Another 24 completed wells are shut in pending construction of a major pipeline outlet. More are drilling.

Output now is limited by the capacity of a small local refinery.

Slipping Austrian production fell below 60,000 bbl. daily because of a further decline in Matzen-Auersthal field. Matzen, the largest field in western Europe, accounts for more than 80 per cent of Austrian production. Its January-June average of 49,400 bbl. daily was off 2,400 from the first half of the year.

TREND OVER THE LAST YEAR

1956—	Western Hemisphere less U.S.	Middle East	Total, Free World outside U.S.
July	3,532.0	3,803.5	7,981.2
August	3,618.2	3,685.8	7,965.6
September	3,637.2	3,721.8	8,019.3
October	3,688.3	3,873.5	8,251.8
November	3,760.8	2,142.8	6,544.2
December	3,915.9	2,428.9	6,989.7
1957—			
January	3,993.9	2,645.7	7,301.7
February	4,040.7	2,855.5	7,561.6
March	4,117.8	2,764.3	7,582.0
April	4,111.5	3,140.0	7,985.0
May	4,116.0	3,556.1	8,407.3
June	4,160.6	3,957.3	8,872.5
July	4,070.1	3,989.4	8,815.1

Crude-Oil Production Over the World

(Daily average in thousands of barrels)

Country—	July 1957	June 1957	July 1956
Western Hemisphere:			
Argentina	95.5	95.5	80.4
Bolivia	9.6	9.6	8.6
Brazil	25.0	23.7	7.7
Canada	530.0	528.3	459.6
Chile	11.8	11.6	10.0
Colombia	124.0	126.4	120.6
Cuba	1.1	1.0	1.5
Ecuador	7.7	7.7	9.7
Mexico	240.0	240.0	246.5
Peru	52.8	52.8	49.7
Trinidad	95.1	95.4	78.5
Venezuela	2,877.5	2,968.6	2,459.2
Total	4,070.1	4,160.6	3,532.0
W. Europe & Africa:			
Algeria	0.3	0.3	0.5
F. Morocco	1.6	1.6	2.0
Egypt	52.3	49.0	37.9
Gabon*	4.0	4.0	
Austria	59.1	60.2	63.4
France	27.8	28.7	23.7
W. Germany	77.7	76.4	69.2
Italy	25.9	27.7	10.0
Netherlands	29.4	29.4	21.1
Turkey	6.5	6.5	6.5
United King.	1.6	1.6	1.3
Yugoslavia	7.6	7.6	5.5
Total	293.8	293.0	241.1
Middle East:			
Bahrain	32.5	30.1	30.0
Iran†	760.0	735.0	597.0
Iraq‡	464.2	435.9	763.8
Israel	1.2	1.2	0.6
Kuwait	1,288.0	1,370.0	1,204.7
Neutral Zone	75.0	75.0	43.4
Qatar	158.7	145.8	130.4
Saudi Arabia	1,209.8	1,164.3	1,033.6
Total	3,989.4	3,957.3	3,803.5
Other Asia:			
British Borneo	120.0	120.0	118.6
Burma	5.0	5.0	4.5
India	8.5	8.5	9.2
Indonesia	310.0	310.0	253.9
Japan	6.1	5.9	5.8
New Guinea	6.3	6.3	6.8
Pakistan	5.9	5.9	5.8
Total	461.8	461.6	404.6
Free World:			
Foreign	8,815.1	8,872.5	7,981.2
United States	6,873.0	7,107.0	7,090.0
Total	15,688.1	15,979.5	15,071.2
Communist countries in Soviet orbit:			
Romania	220.0	220.0	200.0
Russia	1,950.0	1,930.0	1,600.0
Others	50.0	50.0	50.0
Total	2,220.0	2,200.0	1,850.0
World total	17,908.1	18,179.5	16,921.2

*New listing. Pointe Clairette-Ozouri area went on commercial production in February.

†Includes 4,000 bbl. daily from Naft-i-Shah field not operated by consortium companies.

‡Includes estimated 5,000 bbl. daily from Naft Khaneh field, operated by British Petroleum Co.

Figures are from reliable industry reports or official government sources. Data for Communist countries in the Soviet orbit, which includes the European satellites and Red China, are based on competent estimates. Authentic information is not available on month-to-month production in these areas. Estimates also were made for those countries, particularly in Southeast Asia, where complete reports are lacking.

How to Get Your Money's Worth From Your MUD PUMPS . . .

Installation Operation Maintenance

By J. O. Scott

JOE knows his mud pump has a big job to do. In today's rotary drilling, the amount of mud and the pressure the pump can put out determines in large part how fast and how successful his drilling efforts will be.

So Joe has his work cut out for him. First of all he has to keep the pump running. Those down times working on the pump may cost a lot of expensive rig time. But in keeping the pump running, Joe has to be sure it runs well. Unless he can get it to put out all of its horsepower, he knows his drilling rate will suffer. And then there's the problem of keeping the expenses of pump maintenance to a minimum. Otherwise, they'd cut pretty deep into what profit he's making.

That's why Joe is particular about how his mud pump is set up, operated, and maintained. He makes sure the pump has good suction. That way it will deliver its rated amount of mud. And it won't develop those fluid-end knocks. On the other side of the pump, Joe makes sure his pulsation dampener smooths out those pressure surges which put an extra load on the pump and also harm the downstream piping, hose, and swivel.

But after the pump is set up and operating, Joe doesn't forget about it. He knows a regular inspection program with replacement of worn parts is less expensive than waiting till something gives out. And when worn parts are replaced he makes sure his crews use proper methods.

Joe is careful not to forget the power end either. That means being sure it's lubricated and oil is changed when needed. Joe knows it's very important that the pump isn't overloaded. He knows its life will decline rapidly if that happens. He doesn't like to compound pumps but when he needs more volume or pressure than one pump will deliver he makes sure the pumps tied together are adequately protected by proper equipment.

Joe has a lot of know-how he uses to keep his mud pump at its best. And this helps him keep his costs in line. But Joe doesn't have a monopoly on this know-how. You can have it too. The following pages give you much practical information about your mud pump, its needs, and methods you can use to keep it pumping at its best.

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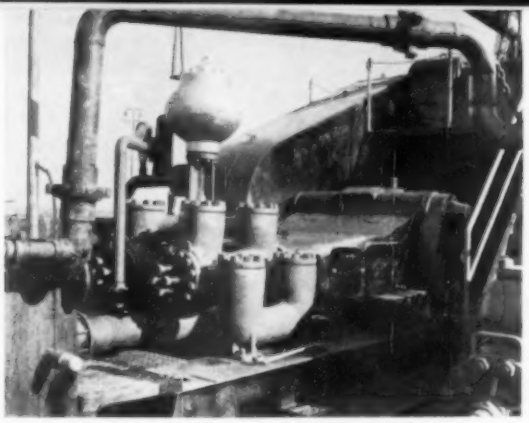
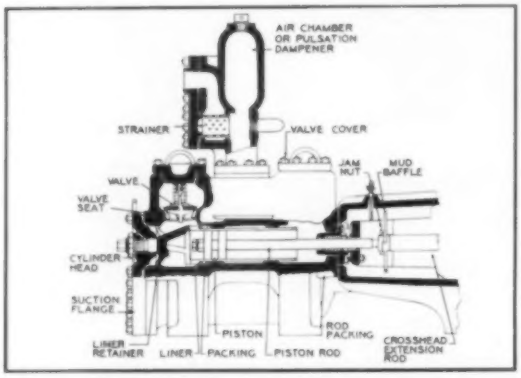
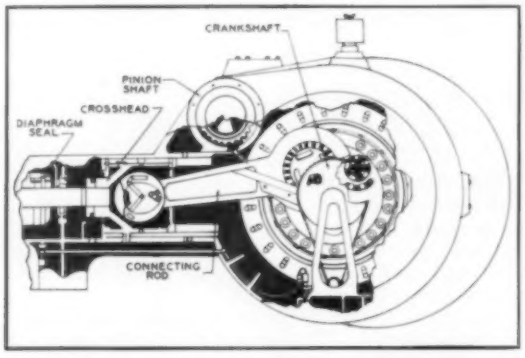


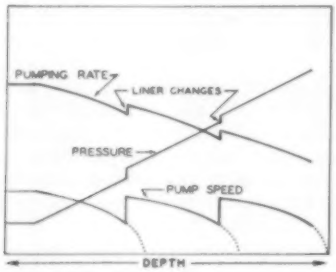
THE MUD PUMP is an important part in determining how fast the drilling will be, how good condition the hole is in, and how much money You'll make.



FLUID END OF PUMP must be kept in good condition to get the highest efficiency and best performance.



POWER END OF PUMP determines pump's capacity. Operating conditions must be chosen to keep from overloading this part.



POWER SLUSH PUMPS operate in a limited speed range. As pumping pressure increases with depth, liners are changed to keep from overloading the pumps.

Getting the Most From the Pump

Power needed for mud circulation on rotary rigs has increased considerably in recent years. This has come about by the use of mud power to speed drilling. In order to satisfy the jet bit and keep the hole clean, circulated volumes and mud pressures have increased. This has not only increased the costs of mud-pump operation but has demanded bigger, and more expensive, pumps.

Balancing the costs . . . In many areas, increasing the pump output will increase drilling rate. But if the pump operates poorly, high maintenance costs may offset drilling-rate savings. Increasing output also costs more. This is especially true when pressure increases. For example, average daily maintenance costs for pumps on rigs rated to 5,000, 8,500, 12,000, and 15,000 ft. have been found by one company to be $14, $27, $35, and $42.

Using a pump too small for the need increases maintenance costs and decreases life. But using a pump that is too large is expensive in terms of high initial cost and costs of moving it from location to location. The least expensive route is to use a pump that is just adequate for the task. This means the pump must operate at top efficiency under the most severe conditions.

Is Your Pump Adequate?

Pumping requirements vary from low pressure, high volume at shallow depths to low volume, high pressure for deep drilling, to high volume, high pressure for jet-bit drilling. The hydraulic power this will take depends on both volume and pressure. They are related by the equation:

$$Hp. = (g.p.m.)\ (psi.)/1714. \qquad (1)$$

At its rated speed, your pump will reach its power rating at the maximum rated pressure for each liner size. Large liners give high volumes and lowest pressures. As liner sizes are reduced, pressures are increased, but volumes are less.

Even when the pump is operating at maximum pressure its horsepower output will be less than its pinion-shaft rating. Usually hydraulic horsepower is about 85 per cent of this rating.

Power calculations . . . To determine the power needed for a given hole, you should first find out what volumes of mud will be necessary to give you enough velocity to remove cuttings. This annular velocity varies according to the type of formation drilled and the drilling rate. For several areas, the minimum rate needed has been found to be about 100 to 150 ft. per minute.

When you know volume, by means of charts or calculators determine the pressure loss in the drill pipe and hole for different depths. When you add to this the pressure drop for surface piping, rotary hose and swivel, and the pressure drop across the bit, you will get pump pressure. Then pressure times volume by Equation 1 will give you needed hydraulic horsepower.

For drilling with jet bits, the power required will be greater than for drilling with conventional bits, because of the higher pressure drop across the bit. Charts are also available for determining pressure drop across a jet bit for combinations of nozzle size and pumping rate.

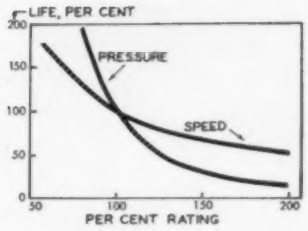
Overloading Is Costly

Frequently, desired volumes and pressures for today's drilling exceed those for which a mud pump is rated. This leads to a temptation to speed up a pump beyond its rating or pump beyond given pressure limits. Either practice decreases pump life and increases fluid-end maintenance.

Bearings in a power-pump drive have a life which varies as the reciprocal of the load cubed. For instance, if a pump would last 10 years if operated at a rated 1,000 psi. with a 7½-in. liner, it would last only 3 years if operated at 1,500 psi. $(10/(1.5)^3)$.

Now if the same pump were rated at 65 s.p.m. and were operated at 100 s.p.m., then the life would be reduced to 6.5 years. Bearing life is inversely proportional to speed of operation.

When it is necessary to operate a pump to produce more than its rated horsepower, these calculations show that it would be better to increase speed rather than pressure. Each has an equal effect in increasing horsepower.



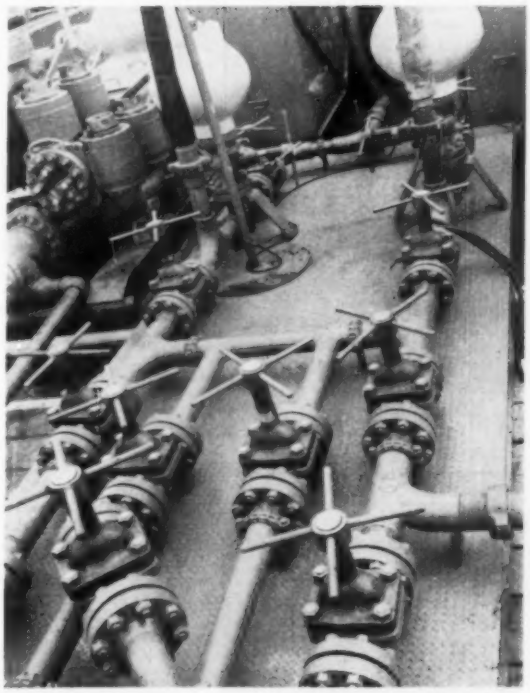
PUMP LIFE depends on the pressure and speed of operation.

Compounding and Paralleling

Where a single pump will not produce optimum volume or pressure, two pumps may be used together. Paralleling, where pumps take separate suction and pump into a common manifold, doubles volume output for any size liner. But liner sizes must be reduced as pressure increases just as with a single pump. Compounding, or two pumps in series, increases allowable pumping pressure. The pressure is divided between the two pumps. Large liners may be used for high volume but the allowable pumping pressure is doubled.

Some manufacturers do not advise these practices, because of the precautions that must be taken to avoid injury to the pumps.

When pumps are effectively protected, compounding of small pumps can have advantages over a single large pump. Compounding will give additional pressure which will speed drilling with jet bits. If one pump is stopped, drilling is not seriously hampered. More days of operation can be covered without changing liners.

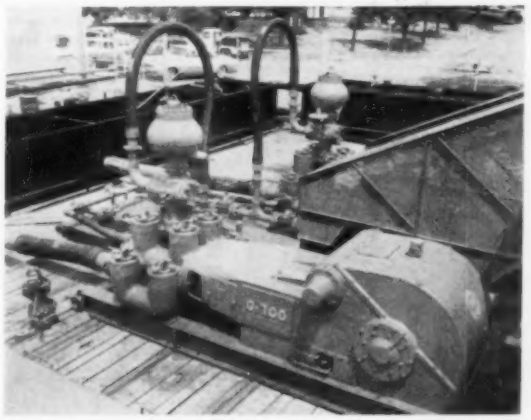


MUD MANIFOLD can be used for either series or parallel operation of pumps.

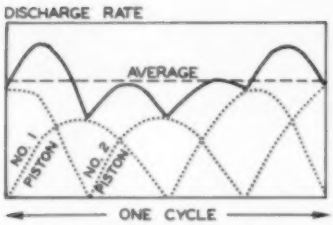
Precautions . . . More elaborate precautions are necessary with compounded pumps. This is not so much a problem with steam pumps as with power pumps. With steam pumps, the low-pressure pump can speed up or slow down to fit the requirements of the high-pressure pump. The two are cushioned together. With power pumps, however, the speed of either pump is essentially constant. A slight imbalance in output could tear up the pumps.

Two important steps in compounding are to equip the discharge of the low-pressure pump with a pulsation dampener and to provide both pumps with a fluid drive. For this use a straight fluid coupling is safer than a torque converter because its maximum output torque can not exceed the input torque. The pulsation dampener should have adequate volume to compensate for the different volume passing through each pump during the various parts of the pumping cycle.

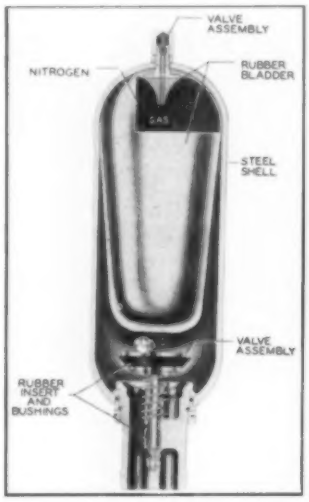
For a duplex pump, the instantaneous rate of discharge goes through a peak on each stroke. On the stroke of the rod end the rate is less than on the other end. This produces the volume and pressure pulsations



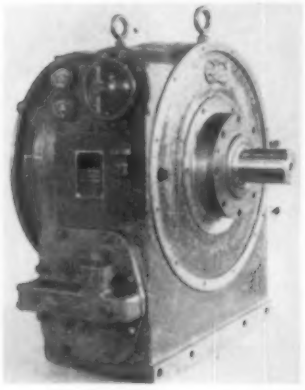
VIBRATION IS REDUCED by use of pulsation dampeners and vibration hose. These are recommended for series or parallel operations.



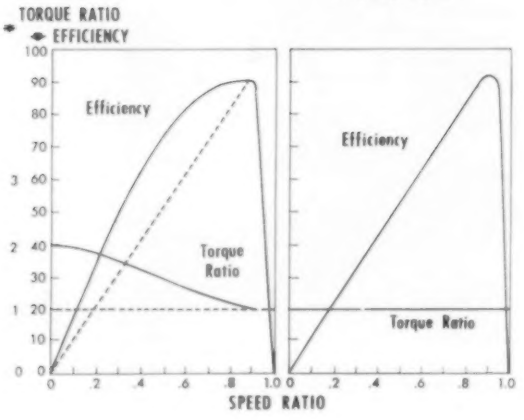
PRESSURE PULSATIONS result from the fluctuation of discharge rate of the pump. Parallel operation may increase these fluctuations.



DIAPHRAGM - Type dampeners hold a precharge of gas and prevent contact of gas with mud. Compounded pumps require pulsation dampeners.



A TORQUE converter provides flexible drive which reduces pulsation peaks. Fewer liner changes have to be made with this type of drive.



FLUID - DRIVE performances are shown by curves for torque converter, left, and fluid coupling, right.

MUD PUMPS

which must be damped out. A precharged piston or membrane-type dampener is necessary, for the conventional air chamber may lose its charge with time.

To further guard against pressure surges and vibrations when compounded a flexible hose should connect the discharge of the low-pressure pump to the suction of the other. A pressure-relief valve is a must on this line connecting the two pumps.

Paralleling . . . In paralleling pumps, a pulsation dampener on the discharge is also necessary. The ordinary pressure fluctuations of a single pump may be magnified when pressure peaks of each pump coincide. These are highest when pumps are in phase. Studies show that the lowest magnitude of pressure surge is obtained when the cranks of the pumps are operating 140° out of phase. Reduction of surges increases pressure capacity when pumps operate in this manner.

Advantages	Disadvantages
Series—	**Series—**
1. Divides power load between pumps. Twice small-liner pressure is limiting pressure.	1. Additional investment is required for dampeners, relief valves, suction blinds, and vibration hoses.
2. Larger liners are used. When one pump is off, volume and power are not penalized as much as with parallel pumps.	2. Special techniques must be used to start and stop pumps to avoid damage.
3. Low-pressure pump has only half operating pressure on fluid end. Less fatigue on this pump.	3. Pumps cannot be run at same speed. Different prime movers are needed.
4. Pressure differential across pistons and valves is only one-half line pressure.	4. High-pressure pump has abnormally high pressure on fluid end—more pump fatigue.
	5. Protection of the pumps depends on the proper functioning of dampeners and relief valves, which might fail.
Parallel—	**Parallel—**
1. Divides power load between pumps. For deep drilling, small liner pressure rating is limiting pressure.	1. Pulsation dampener needed to compensate for bigger pressure pulses.
2. Pumps may be run at same speed from common compound.	2. When one pump is off the line, volume is cut in half.
3. No special operating techniques are required to start and stop pumps.	3. Pressure differential across pistons and closed valves is equal to full line pressure.
4. Power may be distributed flexibly between pumps.	

Should You Use Hydraulic Valves?

The two types of hydraulic drives used on mud pumps are the fluid coupling and the torque converter. Both are used to provide more "give" in the coupling between the prime mover and the power end. This flexibility cuts down shocks and vibrations, makes the pump run smoother, and prolongs pump life.

Fluid drives are especially recommended where pumps are coupled or compounded. Pressure pulsations are apt to be more severe in this service and the drives give the pumps more protection. Peak pulsations are reduced by the fluid drives.

In compounding pumps, the straight fluid coupler is sometimes preferred over the torque converter. This is because it cannot transmit a higher torque than put into it. The torque converter, on the other hand, multiples the input torque and could put an extra strain on the pump if pressure between pumps should increase suddenly. In this service a single-stage converter would be preferred over a multiple-stage because of lower torque multiplication.

For normal or parallel pumping the torque converter has the advantage of using maximum engine power for an increasing load. As load increases, engine speed remains constant while the pump slows down. Hydraulic horsepower is kept constant. As a result, a given liner may be used longer and many liner changes are avoided.

How they work . . . The engine can be operated at its most efficient speed when using hydraulic drives. The fluid coupling is an essentially constant-torque device. Maximum output is equal to input. As load increases, coupling output speed decreases and engine speed will drop to produce maximum torque. Output of the coupling rises to this torque and remains there even as its speed decreases to zero.

The torque converter, on the other hand, multiplies input torque by means of a series of pump-turbine stages. When stall conditions are approached, its speed decreases but its torque increases. At complete stall the torque is maximum. It has a value equal to the multiplying ratio times the engine torque.

While it is possible to overload a pump with a torque converter, careful matching with engine will reduce this chance. The torque multiplication and the chosen operating speed should produce maximum pump speed when delivering maximum output power.

One criticism of the use of fluid drives is that they decrease the efficiency of power use. They are only about 85 per cent efficient. However, they allow the engine to operate at most efficient speed throughout the range of each liner. This improvement in engine operation usually compensates for the power loss.

Mount Your Pump Right

A lot of pump trouble can be traced to the way it's mounted during rigging up. If the sheaves on the pump are not aligned properly with the sheaves on the compound, the result may be continual V-belt breakage. If such a condition continues too long, the gears and bearings of the power end may suffer.

The base on which the pump skid rests is important. It should be as nearly level as possible and also firm so the pump won't rock or vibrate excessively during operation. Where the pump is driven from the compound, it should be braced against the substructure. This not only keeps the belts from getting loose but when the braces have a screw adjustment the tension can easily be adjusted without reblocking the pump.

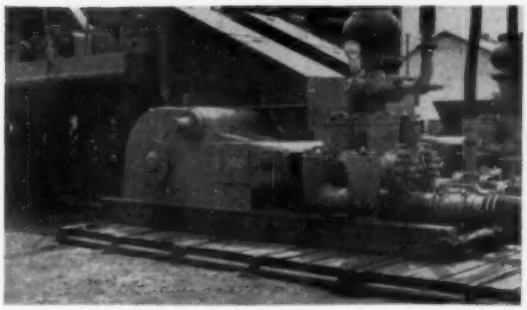
V-belts . . . When installing V-belts move the pump back toward the driver so that the belts won't be damaged by being forced onto the sheave. The load side should be the tight side and the belts on this side should be even.

To check the correct tension in the belts, pull the slack side down with the thumb and forefinger. A give of about 3 in. is correct.

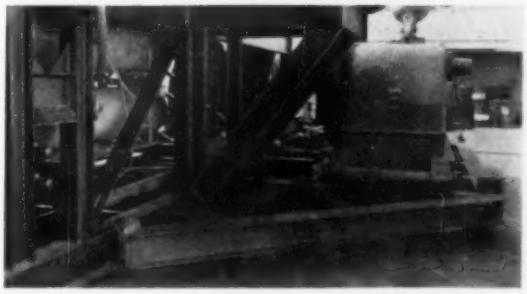
If you are using a chain drive on the pump it will be in for a lot of vibrational and shock loading and high maintenance unless you use a hydraulic coupling or torque converter.

Provide Adequate Suction

Unsatisfactory slush-pump operation can often be traced to poor mud suction. If the cylinder doesn't



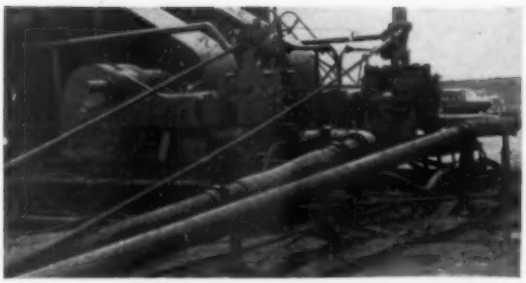
A GOOD solid base is important to good pump operation. This base has planks bolted to pipe frames for easy moving.



ANCHORING THE PUMP on the compound is aided by this base bolted to the substructure.

AN ADJUSTABLE brace speeds pump alignment to compound and keeps belts tight.

A GOOD SUCTION MANIFOLD has a short and direct suction line with no turns. Suction line is same size as pump suction and tanks provide good suction head.



AVOID BENDS IN MUD LINES to insure good operation of the mud pump and mud system.

SUCTION booster stores mud during input surge and delivers it at the start of a stroke. It smooths pump operations at high volumes.

SUCTION BLINDS should be full opening. Be sure they are open when you start the pump. Other possible restrictions are suction strainer and collapsed suction hose.

GOOD MUD SYSTEM keeps air and gas out of the mud, cools it well, and prevents solids from getting to pump suction. This is necessary for good pump performance.

fill completely on each stroke, the result is hammering and poor pumping.

With normal unassisted suction the maximum head available to force mud into the pump cylinder is atmospheric pressure. This may vary from 14.7 psi. at sea level to 11.8 psi. at 6,000-ft. elevation. This is equivalent to a head of water of 34 to 27 ft. If the mud level is above the pump suction, the head is increased and mud will flow faster. A lower mud level decreases the head available to flow mud.

Minimize restrictions . . . To best use the driving force, minimize flow restrictions in the suction line. The bigger the suction line, the lower the pressure drop. The suction line should have a diameter at least as large as the pump suction.

The length of the suction should be kept as short as possible. Turns and bends should not be used if they can be avoided. They increase pressure loss. Any necessary turns should have a large radius.

Other places that should be checked for restrictions are the suction strainer and suction-line valve. A good mud-pit design should keep down strainer clogging. The valve should be full opening.

Keep out gas . . . Even though flow restrictions are small, gas in the mud may also cause poor fill-up and poor pumping. Gas may be circulated up with the mud, or if the mud is very hot, it may actually boil in the cylinder, forming vapor. Boiling can occur at temperatures much less than 212° F. because on the suction stroke mud pressure is reduced below atmospheric pressure.

The solution to these problems is to provide a good mud-system design. Adequate pit area must be available to cool the mud to at least 150° F. Degassing equipment or a long flow ditch and baffled tanks will remove gas. Avoid gunning the pits in a manner so that air is entrained in the mud.

Boost suction . . . With high-volume pumping rates the pump may pound despite precautions. The problem is that with duplex pumps the mud must be speeded up and slowed down four times each cycle. The mud resists these changes and causes suction pressures to vary alternately from somewhat below atmospheric pressure to somewhat above atmospheric pressure.

One way to alleviate this problem is to use a surge dampener to store the pressure-inducing surges and to give a little extra push at the start of a stroke. A more uniform suction pressure is obtained and the pump will run at higher volumes without knocking.

Another method of boosting pump volume without trouble due to incompletely filled cylinders is to use a supercharging pump on the suction. This is a high-volume, low-pressure centrifugal pump which assures filling of the cylinder during all parts of the stroke.

You should remember that even if the pump runs smoothly when you boost the volume output, speeding up the pump beyond its rating will decrease its life.

Rigging the Pressure Side

Every slush pump should be equipped with a surge chamber and a pressure-relief valve on the discharge end. The surge chamber cuts down on the pressure pulses which cause shock in the pump, rotary hose,

swivel, and standpipe connections. The relief valve prevents overloading and injury of the pump if mud flow is blocked.

Surge chambers may range from the common air chamber to a piston or diaphragm-equipped chamber. The advantage of the separator-type chambers is that they may be loaded with inert gas and will retain the charge. Air in contact with the mud in the simple chambers will gradually be dissolved and the chamber must be continually recharged to be effective.

Always be sure the pulsation dampener has the correct charge to damp the pressure pulsations. This charge pressure should usually be about three-fourths of the average discharge pressure. If you are running at low pressure and the charge is high, the dampener is inoperative

Relief valve . . . A relief valve is no good if it does not open when the pressure is too high for the pump. Always be sure that the nail in the valve is the proper size for the liner.

Or if the valve doesn't require different sizes of nails be sure the nail is in the right hole. Remember that the nail must be changed every time the liner size is changed.

Be sure that the relief valve will not discharge onto a workman if it blows. Use a cover so that pieces of nail won't hit anyone when it shears. Also you should take care that the relief line will not stand full of mud in freezing weather nor should mud be allowed to dry out in it. In either case it would become plugged and the valve would be ineffective. If you run the relief line back to pump suction be sure the valve will not let air into the line. Air sucked in may cause the pump to knock.

A strainer on the pump discharge will be desired if jet drilling is to be done. This will pick up bits of foreign material that may clog the jets of the bit. However, you should check this strainer often to be sure it doesn't become so clogged that it will block the mud discharge and create pressures too high for the pump.

Other points to remember are that the discharge manifold should be as short as possible and that sharp turns should be avoided. Keep the discharge line simple and direct and you will cut out much of the vibration which causes line fatigue and connection failures. A vibration hose is very helpful.

What About the Standby Pump?

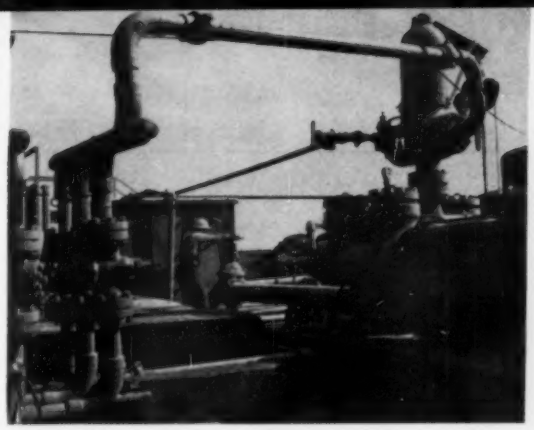
You may be able to run the standby pump from the compound or you may run it with separate drive. But be sure to rig it so that it will give best service. The same rules apply to setting up the standby pump as apply to the main pump.

Be sure to put the standby pump on a firm and level base. It may not be used except for mixing mud or jetting the pits but take care that it has direct discharge lines with few bends. The suction line should be as short as possible and as large as the pump suction.

Always keep in mind that you may also need to use the standby pump on the well besides just mixing mud. So hook it up in the same way as you would your main pump.

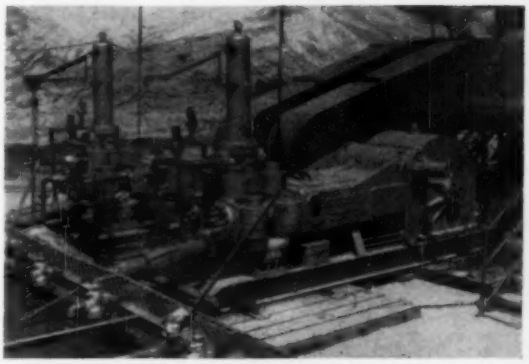
Oil-Bearing Mud

Oil-base or oil-emulsion muds dictate special choice of the rubber valve and piston parts. Ordinary rubber



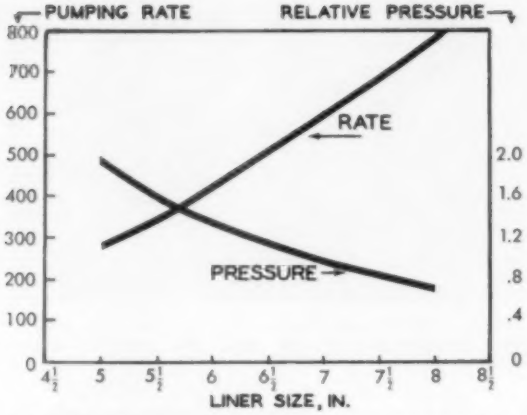
RELIEF VALVE should be covered to prevent injury when it trips. Discharge line to tank rather than suction eliminates chance of getting air into suction.

DISCHARGE strainer should be used during jet drilling. Keep it clean of foreign material which may plug jets or put extra pressure on pump.

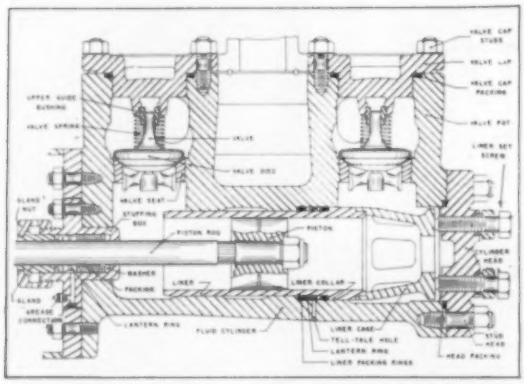


STANDBY PUMP should also be rigged with pulsation dampener and relief valve. It should be able to pump just as efficiently as main pump.

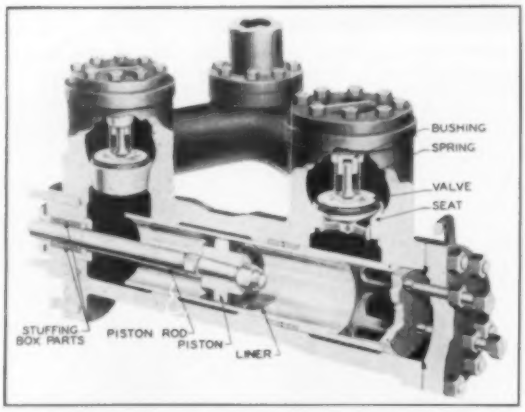
LOW-ANILINE-POINT oils will destroy oil-resistance rubbers like this piston rubber. Test any oil put into the drilling mud.



PUMP OUTPUT changes in this way as liner sizes are reduced. Smaller liners must be used for higher pressures to keep from overloading pump.



VITAL PARTS of the fluid end should be protected through a regular maintenance program. If one part wears out completely, it may cause another part to fail.



RELATED LIFE of these groups of parts should form the basis of replacement. When one part fails, the other parts should be changed or closely inspected so that downtime may be minimized.

will not function in these fluids for any length of time. Special synthetic rubber that will not soften and deteriorate in these fluids is available and should be used.

Even the oil-resisting synthetic rubber will not stand up well on exposure to certain types of oil. Before any oil is used in a mud it should be tested to determine its effect on the rubber pump parts.

Types of oils that should not be used in a slush pit are those with high aromatic content, as measured by the "aniline point." This is determined as the temperature at which aniline and the oil become miscible. The higher the aniline point, the less the aromatics, and the better the oil is for use in the slush pump.

Desirable aniline points of oils are from 160° or more. Some oils with aniline points as low as 140° have been used successfully but these usually are harmful to the pump rubbers.

How to Determine Pump Output

Although the mud pump will run at essentially constant speed, the speed decreases as load increases. When the load becomes too great, a smaller liner must be used. Volume output decreases with speed and with smaller liner size. The following table shows how much fluid the pump will deliver with various liner sizes, stroke lengths, and speeds.

You should change to a smaller liner and thus to lower volume whenever the discharge pressure reaches the rated pump pressure. The pressure rating increases with smaller liners.

AVERAGE PUMPING RATE OF DUPLEX PUMPS
(G.p.m. at 60 s.p.m.)

	Liner, Diameter, in.						
Stroke, in.	8	7½	7	6½	6	5½	5
20	982	856	738	628	525	431	346
18	884	771	664	565	472	388	311
16	795	694	599	511	429	354	286
14	703	614	531	454	382	316	257
12	607	531	460	394	332	276	225

*At 100 per cent volumetric efficiency. Average rod volume deducted. To obtain volume at other speeds, divide volume by 60 and multiply by actual strokes per minute.

Different pumps will have different pressure ratings with the same liner, however. The rating is determined by the load on the piston rod. This is the product of the pressure and the liner cross-sectional area. The following table shows the relative pressure rating with different size liners. If you know the pressure rating with one liner size, divide this by the factor for this size and multiply by the factor for another size to get the rating for the other size. For example, assume the pump has a 1,000-psi. rating with a 7½-in. liner. You want the rating with a 5-in. liner. Using relative pressures from the table, the 5-in. rating would be: 1,000 $\times 1.96/.862 = 2{,}270$ psi.

RELATIVE PRESSURE RATING OF A PUMP WITH CHANGE IN LINER SIZE

(7-in. pressure = 1)

Liner diameter, in.	8	7½	7	6½	6	5½	5
Relative pressure	0.765	0.862	1.000	1.161	1.361	1.617	1.960

Pump-Maintenance Program

It is false economy to use expendable pump parts until they wear out completely. If leaking piston rubbers or valve inserts continue to operate until complete failure, the result may be replacement not only of these parts but replacement of fluid-cut liner and valves as well. A worn-out rod packing might ruin a rod. Or a leaking liner packing might cut out a liner and the pump cylinder as well if left operating too long.

The solution to these problems is a regular inspection and maintenance program. Finding and replacing worn parts before they give trouble will save more expensive replacements.

. . . Group replacements. Parts should usually be replaced in groups that have similar life expectancies. When a part in this group needs to be replaced, then the other parts should be checked closely to see if they should be replaced. This will save unexpected and frequent shutdowns. As an example, liners and pistons will serve about the same length of time. A new piston should be used when a liner is replaced. If the piston wears first, check the liner closely for excessive wear, also. Other parts with related life might be stuffing-box parts and piston rod, valve bodies, valve bushings, and valve springs. A service record on each pump shows how to make groupings.

Even though one related part may appear to have some useful service left when another wears out, leaving it in operation may reduce the life of the new part. A worn liner, for instance, will shorten the life of a new piston. Liner costs may be reduced, but piston costs will go up. And shutdowns for repairs will be more frequent.

Frequency of pump inspection may vary according to the pumping conditions. A good time to give the pump a thorough inspection is between wells. When a pump is to be used a long time on a well, inspections should be timed to coincide with regular liner changes. At this time the condition of valves and piston can also be observed. Careful records of the life of different parts in running hours will also help to set up an optimum inspection frequency.

How to Maintain Fluid End

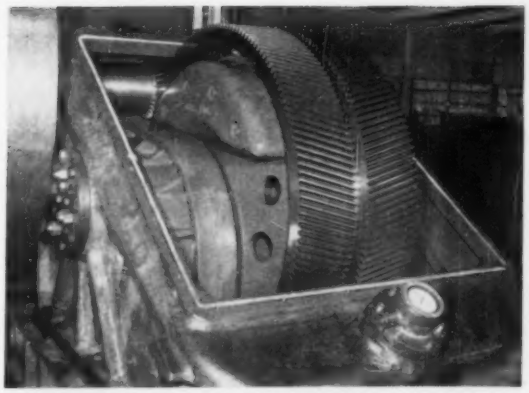
Good service from the fluid end depends on care of the pump both during pumping and during storage. To start with, consider proper protection of the pump and parts during storage.

Storage . . . Idle pumps, especially standby pumps, should be protected from rust and corrosion by coating exposed rods and other surfaces with a light grease. Wipe rods clean to remove any wind-blown grit before you start the pump.

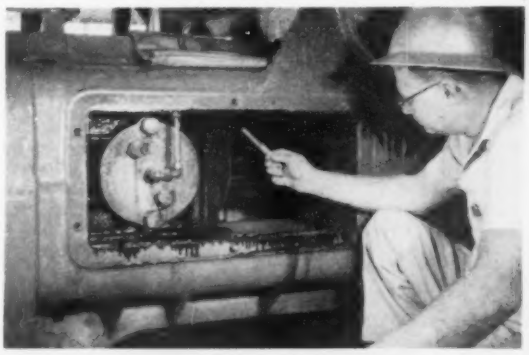
When the pump is stored for a length of time, you should drain the fluid ends, remove liners, pistons, rods, and valves. Clean them and the pump cylinder thoroughly and give them a coat of grease. If you leave such parts idle in place very long, they will rust and deteriorate.

You need spare parts on hand to make repairs when necessary. But they are wasted if they are damaged by careless handling or storage. They should be kept in a protected place where heavy tools and other parts won't be dropped on them.

Here are some things to watch. Rubber parts should



POWER END should be inspected during down times to check wear and possible trouble later. Keep an eye on the oil gage or dip stick to be sure the pump is lubricated at all times.

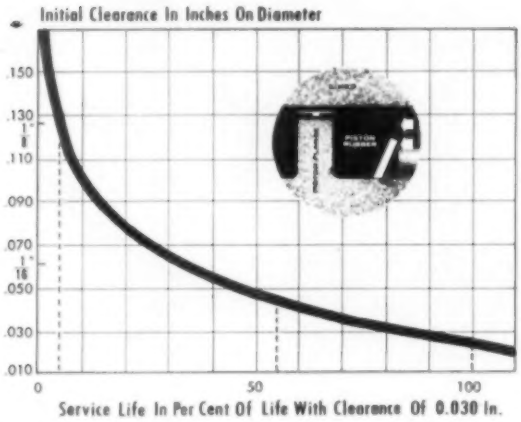


CROSSHEAD WEAR could mean uneven piston, rod and liner wear, and possible rod breakage. Tighten shoes if feeler gage shows too much wear.

JAM NUT that is worn out of square could cause . . . .

. . . ROD BREAKAGE because of high stress concentration.

USED LINER should be checked by calipers for wear. Be sure it is not streaked or pitted.



PISTON-LINER CLEARANCE on diameter should be less than 1/16 in. Clearance should be less for higher pressures.

TELL-TALE HOLE should be kept clean so that it can show the least bit of mud leakage around the liner packings.

be protected from heat and distortion. Leave them in their original packages. Don't hang packings on a hook. Be sure pistons don't get cut on the sealing lips which ruins them. Don't leave pistons on their side for long periods of time; the lips may distort. Use a special rack for rod-and-piston assemblies.

Inspecting the pump . . . Before you start up a pump, check the condition of all parts. Scored or pitted liners will tear up the fluid pistons in a short time. Damaged pistons or piston rubbers will allow mud leakage which will shortly wash out a liner. Worn, scored, or pitted piston rods will not pack off. Sand or rust caught behind a valve seat may ruin the valve. A damaged valve rubber may allow the valve seat to wash out.

Liners which are undersize on the outside diameter will be too loose in the pump cylinder. This allows the liner packing to extrude into the clearance space and then fail. Keep the liner retainer set up tightly at all times. If it should become loose, the liner will wallow out the fluid end. Any end movement of the liner speeds up the failure of the liner packing.

It will pay to measure the inside diameter of the liner and also the piston diameter. Most pistons have a lip interference of only 1/8 in. on the diameter. A liner or piston worn more than 1/8 in. will allow leakage past the piston, causing damage by fluid cutting. For high-pressure operations the allowable clearance before trouble starts may be as little as 1/32 in. Piston rubber life can be increased 10 times by reducing clearance from 1/8 to 1/32 in.

Rod care . . . Much rod-packing trouble can be traced to too much gland pressure on the packing. This binds and scores the rod. Use only moderate pressure on a smooth rod. If the rod is not smooth, replace it. If the rod is worn more than 1/32 to 1/8 in. in diameter, the packing will not seal well; the rod should be replaced. Less wear can be tolerated at higher pressures.

To prolong rod and packing life keep a freely flowing oil running on the rod. This will increase piston-rod life as much as six times. Always grease connections in accordance with manufacturer's instructions. Keep bushings and washers in the stuffing box in good condition.

Be sure the rods are centered in the stuffing boxes. This may mean adjusting the power-end crossheads or replacing the piston body. Rods not centered deform packing and increase wear. An extra strain is put on the rods and may lead to fatigue failure.

Valves . . . Remember that the rubber part of the valve is the most vulnerable. When it fails the valve body and seat will not last long. Check to see that it is not cut or pitted in the sealing area. Make sure that sand or mud which can start fluid cutting isn't lodged between the rubber element and valve body.

You should replace the valve springs if they are broken, distorted, or have lost their tension. Valves should match up with the springs so that they will open without completely compressing the spring.

A worn or out-of-round valve-stem bushing can be a major source of valve and seat trouble even though it isn't a moving part. When the bushing is out of shape the valve may become stuck or cocked and cause a washout. Clearance between valve stem and bushing should be about 1/32 in. on the diameter for the best performance. Replace if worn more than 1/8 in.

When you put the valve and cylinder-head caps on, be sure that all metal suurfaces are clean and free from sand and rust. If a stud should break, replace all studs on that cap. Chances are that all have been overstressed. Check to see that the stud is right side up. The end on which the nut fits tightly goes into the pump casting. Always run the studs all the way in so that they won't be overstressed.

Be sure to prime . . . Before you start the pump, make sure the fluid end is primed. A few strokes of a piston in a dry liner may ruin it. Prime the pump through the suction-valve cap openings. After you start up, check to be sure no mud is leaking out. Keep the tell-tale hole clean so that any mud leaking through the liner packing will immediately be detected. Don't let any leak continue. You may ruin the fluid end.

Protect the Power End

Remember that your big investment in the mud pump is the power end. Today's pumps are rugged and long lasting, requiring little maintenance on the power end. But that necessary maintenance is very important to continued operation.

Proper lubrication is all important. This means that the oil must be kept at the proper level and that the oil stays clean. If your pump uses a pressure lubrication system the oil pump must be kept running. In this case your inspection program should include checking the oil-pressure gage. Oil level may be checked by opening check plugs or inspecting a dip stick. Cleanliness of oil is helped by an oil filter in line with a circulating pump.

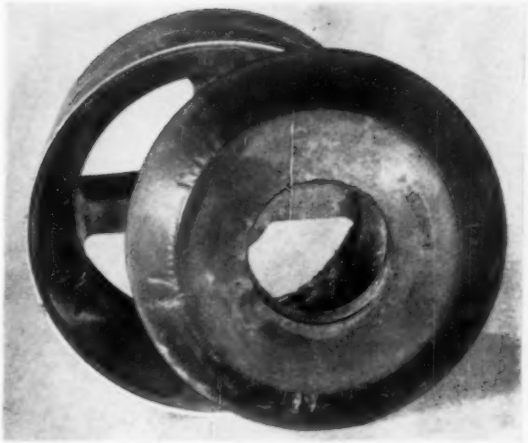
Drain the crankcase . . . Set up a schedule for draining and flushing the pump crankcase. A good frequency is twice a year unless contamination causes need for changing more often. Twice-a-year oil change lets you use a light oil for winter and a heavier oil for summer, just as with your car.

The important point is keeping the oil clean. Dirty oil causes a major part of power-end troubles. A mixture of oil and mud quickly wears the surfaces of bearings, gear teeth, and crosshead slides. Water in the oil will etch and corrode bearing surfaces and gear teeth. They may fail under load.

Mud leaking out of the fluid end may sometimes get past the mud baffle and diaphragm. When this happens, change the oil. Be sure to wipe inner surfaces that the mud contacts. Contamination may also occur when changing rods. This may put dried mud and sand into the crankcase. Remember that replacements will cost you much more than the price of an oil change.

When parts wear . . . Even though the power end is working perfectly, you should inspect it often for possible future trouble. A good time is between wells when you don't need the pump. If something should break down while you're drilling, repairs will cost a lot more.

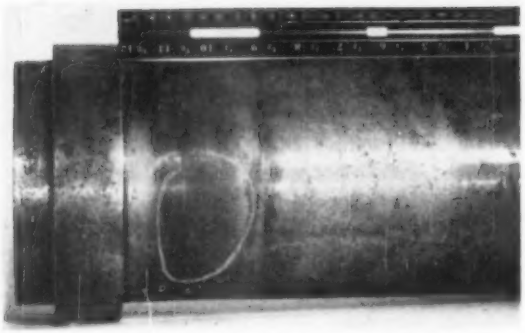
As the pump wears, the power end will need adjustments and possibly replacements. Some bearings can be tightened and this should be done before too much play develops. Make replacements when needed. When bearings and gears are operated in a loose condition, they may develop a slap which shock loads all parts and may cause failure during a critical time.



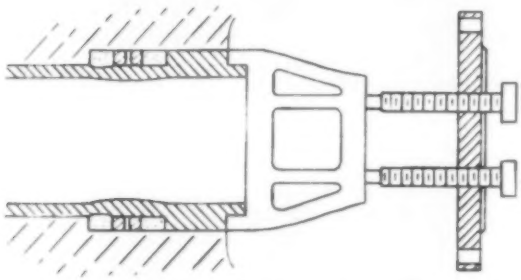
VALVE DAMAGE will occur if foreign matter becomes lodged between valve body and seat. Check valves before you start up.

UNPRIMED PUMP can quickly ruin the piston. Only a few strokes in a dry liner did this damage.

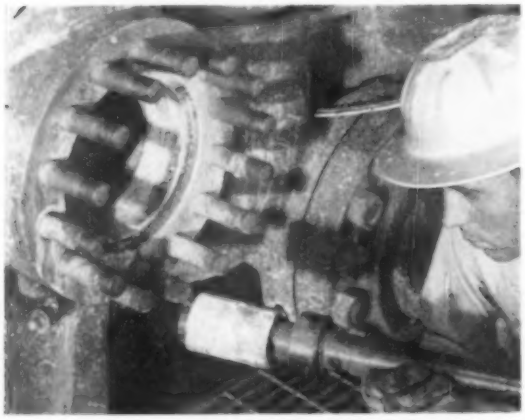
LINER PACKING LEAKED. Either liner-retainer wasn't tightened enough or tell-tale hole was plugged.



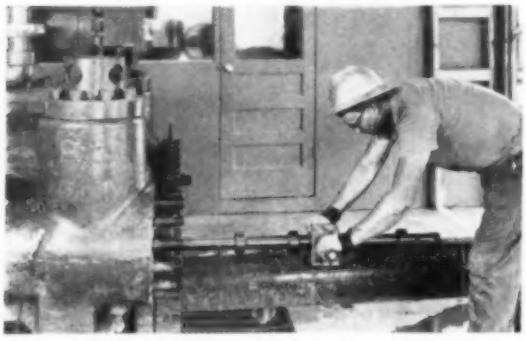
TOO MUCH TIGHTENING of liner packing ruined this liner.



CAUSE OF BOTTLENECKING is usually tightening of cylinder-head nuts without backing off liner-retainer screws.



REMOVING ROD AND PISTON is aided by this tool which screws on to piston end. It can be used to unscrew rod from crosshead.



ROD IS KNOCKED OUT by a special weight and the rod wrench.

If excessive vibration or overheating occurs, shut down the pump. It's a good idea then to call a service man of the pump manufacturer. This usually costs only mileage and an hourly fee. His diagnosis will frequently save you down time and a large repair bill.

How to Change Piston and Rod

When you remove the piston and rod, always think ahead in getting further service from the parts that will go back into operation. This means that the rod should not be hammered on. This may weaken it and cause it to break. Treat pistons gently so that they aren't nicked or cut. Such damage will cause early failure and can ruin the liner.

Before you remove the cylinder head, back out the screws holding the liner retainer. This will prevent possible buckling of the liner if it's replaced. Also this keeps the screws from corroding in place which would prevent them from tightening properly.

Loosening rod . . . Next loosen the packing-gland nut and then the piston-rod lock nut. A bar and a hammer can be used on the lock nut. On some pumps you will need to use a backup on crosshead extension rod.

Loosen the nuts on the cylinder head. A hammer and wrench may be used but a power impact wrench will save time.

Take off the cylinder head. **Be careful not to drop it on your foot.** For bigger pumps, a hoist is advisable for handling the cylinder head. Next, wash mud out of the cylinder and remove the liner retainer.

Now you are ready to take the rod and piston out. Unscrew the piston rod at the crosshead end. You can use a pipe wrench and cheater. A backup wrench may be needed. Keep the teeth of the wrenches off the wearing surfaces of the rods. If you use a special rod-removal wrench, you unscrew the piston rod with it through the fluid end.

Pulling out . . . To pull the piston and rod screw a standard rod nut with a loop welded to it on the end of the rod, hook a chain through the loop and pry out with a crowbar.

If you use the special rod wrench, screw it on to the rod and lock it in place. Then unscrew the rod from the crosshead with a bar in the end of the wrench. To pull the piston and rod use a rod knocker on the wrench and knock the piston free. The tool serves as a handle to lift out the rod.

Piston maintenance . . . Piston rubbers may be replaced without removing the piston from the rod. First, remove the snap ring with a nail and hammer. The end plate will come off easily and allow rubbers to be removed. Clean the piston body well with rags, solvent, and wire brush. Tap the new rubbers into place, for they should fit snugly. Then replace end plates and hammer snap ring into place with special tool or cold chisel. Start square end of snap ring on first to make the job easier.

When you need to remove the piston, remove the rod nut. To loosen the rod nut, you can use two pipe wrenches—one with a cheater and the other on the ground for backup. Be sure to wrap the crosshead-end threads to prevent damage and keep dirt off. A better method is to clamp the rod in a holding tool. One end of the tool fastens to the rod nut. A chain or pipe wrench is used behind the piston to break the nut loose.

Remove the piston with a piston puller or piston

hammer. Do not hammer on the rod. The piston hammer should fit snugly around the rod. A solid support under the end of the rod is necessary.

When the piston is off, clean and inspect the rod taper and threads. Also clean the piston bore. Before a new rod and piston are assembled, the tapers must be clean and dry. Use no grease. Any material left on the tapers may cause the piston to work loose later and let the rod wash out.

Reinstalling . . . After the piston is seated, tighten the rod nut. Correct tightening for different rod tapers is: A.P.I.-3, one man on a 36-in. wrench, no cheater; A.P.I.-4, two men on a 48-in. wrench or one man on a wrench and cheater combination, 72-in. long; A.P.I.-5, two men on a 8½-ft. wrench and cheater combination; A.P.I.-6, two men on a 10-ft. wrench and cheater combination or three men on a 7½-ft. wrench and cheater.

You can reinstall the piston and rod by means of the special rod wrench or with a timber and a sledge hammer. Don't put a new piston into a badly worn liner. Be sure the piston lip follows the chamber of the liner and does not bend back or get torn against the liner face.

When rod and piston are in place, check the stroke. The piston must not come out of the liner at either end. Adjust rod in crosshead to divide piston clearance at both ends.

Always check the rod packing. Put new packing on new rods. Remember that the lips of pressure-actuated packing must point toward the fluid end. Tighten packing gland only enough to prevent leakage.

After you replace the cylinder head be sure the liner-retaining screws are tightened.

How to Change Liner

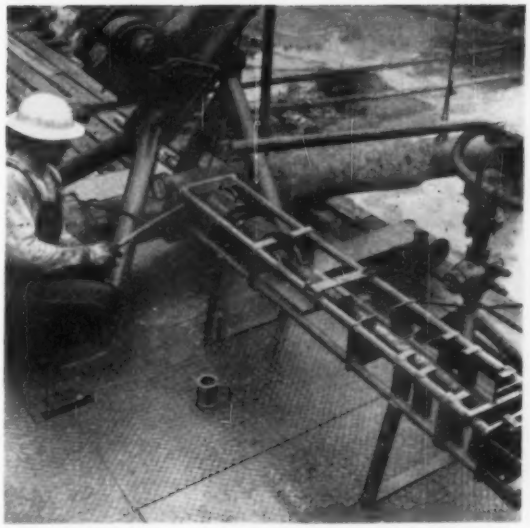
To change the liner, first remove the rod and piston as explained in the previous section. Several ways of pulling liners may be used. One way is to pass a liner puller through the liner and catch it on the opposite end. A knocker slips onto the shaft of the puller and the liner is knocked out.

Another method of removing the liner is to use the engine power. This must be done very carefully to avoid injury to the man and the pump. A pipe or rod is run through the packing gland and set against the head of the liner puller. Power is then applied so the crosshead extension rod pushes against the rod and forces the liner out.

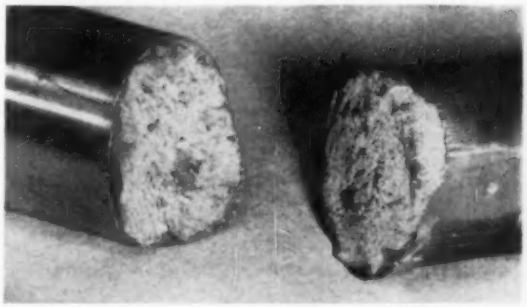
After the liner is out, wash out and inspect the pump bore for fluid cutting. Clean out the tell-tale hole. Check liner with micrometers or caliper for wear. Clearance between piston flange and liner should be less than ⅛ in.

Wash the inside of a new liner to remove grease. Then slip the liner packing over the liner. In some cases, it may aid installation if packing is placed in pump box before liner. Greasing the outside of the liner and packing will help to slide them into place. A long bar will help to insert the liner.

Drive the liner into place, then replace rod and piston. Don't put a worn piston into a new liner. Replace the liner retainer. Be sure the retainer set screws are backed out so they won't buckle the liner. Check the cylinder-head packing to be sure it will hold and replace the cylinder head. After head nuts are tightened, tighten the liner-retainer set screws.

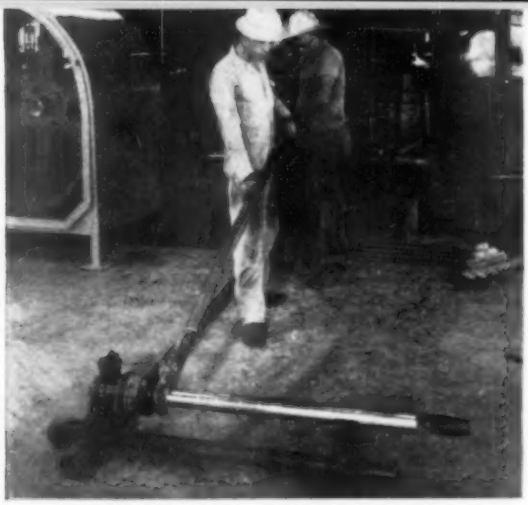


A PISTON PULLER will remove piston from rod with little effort. A piston hammer may also be used.

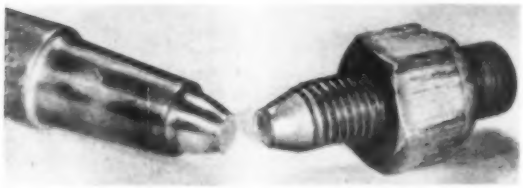


DON'T HAMMER ON ROD itself or it may break like this later on.

CLEAN PISTON and taper with rag and solvent. Both tapers should be clean and dry before reassembly.



TIGHTEN ROD NUT with recommended weight and cheater and wrench length.



ROD PULLED APART when rod nut was tightened with too much torque.

TO PULL the liner you can use this special puller with a knocker. You can also use the power but be very careful.

VALVE SEAT puller locks under seat. The stem is tightened and the wedge hammered up to loosen seat.

MUD PUMPS

In tightening the head nuts, tighten them in a crisscross manner. Tighten one on one side, then one on the other side and so on around till all are tightened. Use the torque recommended by the pump manufacturer.

How to Repair Valves

Older pumps will have valve-pot covers held in place by studs and nuts. Newer pumps may have screw-type covers. An impact wrench is handy for removing nuts and tightening them uniformly. Otherwise you can loosen and tighten them with a hand wrench and hammer. In tightening, use the crisscross method of tightening a nut on one side, then one on the other and so on around. This puts even stress on all studs

After you remove the valve-pot cover, pull out the valve. You can use a hooked wire run through the hole in the valve stem. Remove the valve disk, if there is one, by taking off the snap ring or clamp. Clean the valve body before installing a new disk.

Check body wear . . . Use a valve gage to check the valve body for wear. On a new body, the valve stem will not touch the bottom of the gage slot. On a worn body the stem will touch the bottom of the slot and keep the gage away from the body. Excessively worn bodies will cause short insert life.

If valve springs are broken or have lost their tension, replace them. A new spring should be put on when a new valve body is installed. It's usually good practice to install new valve bushings at this time, also. Clearance between bushing and valve stem should be about $\frac{1}{8}$ in. on the diameter. Check bushings in both the pot cover and the seat. A special puller is needed for the bushing in the seat.

Valve-seat removal . . . Several types of pullers are available when you have to pull the valve seat. With the wedge-type puller, you attach the puller head to the seat and screw the main stem into it. Then you tighten the nut on the stem with the wedge pulled back. Striking the wedge with a sledge hammer frees the valve seat. To protect studs, put a piece of rag in the slot of the wedge.

Hydraulic pullers are much the same. The pulling head is identical. A hydraulic jack pulls up on the seat. Be sure to tie the jack down so it won't fall off the pump when the seat comes loose.

If you should have to burn the valve seat out with a torch, be careful not to burn the valve pot. This would lead to fluid bypassing and much trouble. Only qualified men should be allowed to do this operation.

After you get the valve seat out, wash the valve pot and check for fluid cutting or damage. Repair any damage before new seats are put in. Clean pump bore and valve seat thoroughly before installing seat. All foreign matter, and also grease and oil, must be removed. Drive the seat in tightly, using a driver. A worn valve body and a piece of pipe will do.

Check lift . . . Valve lift should be checked when a valve is replaced. Correct lift is essential to good pump operation. To determine lift, measure the location of the valve with respect to the cover when the valve is in the closed position. Then measure the distance from the cover when the valve is full open. The difference in measurements is the lift.

Check the lift recommended by the manufacturer. If the measured lift is very much different, locate the trouble before installing the valve. Too much lift may indicate you need a new upper guide bushing. Too little may mean the valve and seat are not matched or both may be wrong parts for your pump.

Before replacing the pot cover, clean the sealing surface carefully. For proper sealing, a new gasket or ring may be needed.

How to Sound Out the Pump

When the pump is operating, it may begin to knock. This spells trouble. The knocking may be mechanical or fluid. If it's from the power end it will be mechanical. It can be either mechanical or fluid from the fluid end. Mechanical knocking gives a sharp metallic sound. It will usually occur at all speeds.

If the noise is coming from the fluid end, you can locate the source by using a wrench or rod as a stethoscope. Place one end to the pump and the other to your head. Check each cylinder and valve pot. If the noise is localized, it's probably mechanical. If it's general, it may be fluid knocking.

Mechanical knock . . . If a mechanical knock starts right after the pump starts up, check to see that it has been primed. Recheck all parts that were installed to be sure they are correct in size and were installed correctly.

If valve guides were installed, check valve lift. Check liners for tightening. If cylinder head was off, they should be retightened immediately after the pump starts up. Next check rod lock nut and see that the rod fits the pony rod properly. See that the gland packing is tight enough.

If these steps don't stop the knock, you should remove piston and rod and check piston-end rod nut for tightness. Check the threads to be sure the rod nut will snug up to the piston. Finally, remove piston and clean taper. If piston and rod have run loose any length of time, it is almost certain they cannot be tightened and remain tight. You will save time and money by replacing both.

A fluid-end mechanical knock which takes time to develop may be due to loss of prime. It may also be due to foreign materials wedged in the valves. Check all parts as above to see if any have broken. Make sure the piston rod has not become partially unscrewed.

Fluid knock . . . Fluid knocking can be caused by the suction or discharge conditions. If the suction hose surges excessively, check suction conditions. Strainer may be plugged or suction line filled with sand or drilled solids. Be sure suction blind is open. Also, suction hose may be deteriorated or collapsed. The hose may separate and collapse internally and the outside not show it. Level of mud suction may be too low.

High-speed knock may be due to high mud temperature, plugged suction line, or suction valves stuck shut. Some lost-circulation materials may interfere with valve lift.

When the rotary hose is whipping excessively, the trouble is probably in the discharge system. Possibly the mud is gas cut. Sometimes this may be caused by air leaking into the suction. An air pocket in the suction will cause knock but will rectify itself as the pump runs.

VALVE-BODY WEAR is checked by gage. Turn the gage over and check seat wear.

VALVE LIFT is the difference in measurements between gasket recess and top of valve, left, and gasket to top of valve when it is fully open, right.

PUMP KNOCKING may have preceded the pounding up of this piston on the taper. The taper may have been dirty or greasy. This can also happen if the rod nut is not tight enough.

So you have some tough pump problems . . .

Here are some conditions, causes, cures

CONDITION	CAUSE	REMEDY
Streaking of liner bore and piston rubber	Excess sand or foreign materials in drilling mud. Piston stroking out of liner.	Clean mud. Inspect often. Correct excessive stroke.
Pitted liner	Corrosive conditions.	Use corrosion-resistant liner.
Wear on one side of piston or liner	Misalignment.	Check for worn crosshead slides, worn pump bore, worn stuffing box, or unequal tightening of rod or liner packing.
Bore of liner fluid cut.	Piston is worn or damaged. Some types of pistons cause such damage when they fail.	Install new piston with new liner.
Packing area of liner fluid cut or buckled	Packing may not have been tight enough or may be worn. Cylinder bore may be worn. Overtightening may have buckled liner.	Check liner and bore diameter. See that packing is good. Back out set screws before tightening cylinder head. After head is tight, tighten set screws.
Sealing portions of valve fluid cut	Foreign material in mud or use of new parts on worn metal parts.	Check all parts for wear and replace those worn out.
Fluid cutting between valve seat and pump deck	Sand or rust wedged behind seat. Careless use of torch and damaged pump deck.	See that valve pot is not cut out and that seat fits snugly. Both seat and deck tapers should be clean and dry when installed.
Rod broken through taper	Pump may be misaligned.	Check for uneven wear on rod, piston, and liner.
Rod broken in crosshead threads	Jam nut may be out of square or rods misaligned.	Replace worn nuts periodically. Don't hammer on rods.
Body of rod breaks	Break started by hammering on rod.	Use proper method to remove piston.
Rod pulled apart in taper-end threads	Piston-end nut probably over tightened.	Use recommended method.
Rod wear rapidly or is streaked	Packing over-tightened. Bushings and washers worn.	Avoid use of heavy wrench.
Washed-out taper	Taper not clean and dry when piston installed.	Use proper technique.

To get your money's worth from your mud pump: (1) Make sure the pump has good suction; (2) Make sure the pulsation dampener moves out pressure surges; (3) Set up a regular inspection program with replacement of worn parts; and (4) Lubricate and oil the power end properly and don't overload it.

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DRILLERS' MANUAL ON

HIGH-PRESSURE DRILLING AND BLOWOUT PREVENTION

By Frank S. Bell

About the author . . .

Frank S. Bell is area mud engineer in the New Orleans exploration and production area of Shell Oil Co. He joined Shell in 1948 as a senior exploitation engineer in the Tulsa area, and continued to work in that area until February 1955 when he was transferred to the New Orleans area. He received a B.S. degree in both chemical and petroleum engineering from University of Oklahoma. He served in the Army from 1941 through 1946, being discharged as a major in the Field Artillery. He worked for Mud Control Laboratories in Oklahoma City prior to joining Shell. He is a registered professional engineer in the State of Oklahoma.

EDITOR'S NOTE

The material in this manual was prepared by Bell for use in training personnel in Shell Oil Co.'s New Orleans area. It is printed here by permission of Shell.

It was the complex problems and high cost of high-pressure drilling that prompted preparation of this manual. Shell believes the cost can be cut in three ways:

1. Preventing blowouts.
2. Preventing lost circulation.
3. Eliminating addition of weight material to the mud when it is not necessary.

While a blowout may cost a tremendous amount of money, it may cost even more in human life.

Losses in mud and rig time make lost circulation expensive. When weight material is added to the mud unnecessarily, that costs money too. These two costs coming often over a period of time add up until they cost as much as the infrequent blowouts. This manual aims at showing how all three of these costs can be kept down.

Do drillers NEED blowout training?

Test yourself and find out

In its New Orleans area, Shell Oil Co. has a training program in "Prevention of Blowouts" for all its drilling personnel and production supervisors. Meetings last 3½ hours.

To see if the training does its job, Shell gave a quiz at the beginning of the meeting and another at the end. And, from meeting to meeting, the first test was moved to the end and the end test given before the program. The average grade on the quizzes before the program was 60.4 per cent. The average grade at the end of the meeting was 94.3 per cent.

The two quizzes are printed here. Test yourself and others in your company.

Quiz No. 1 (Prior to training program)

Select the one correct answer from the three or four possible answers given.

1. Most blowouts occur:
   ——— (a) When drilling, (b) When pulling out of the hole, (c) When going into the hole, (d) When completing, (e) When out of the hole.
2. The first positive sign that usually indicates that a well is kicking.
   ——— (a) Gas-cut mud at the surface, (b) Increase in mud salinity, (c) Increase in mud pit level, (d) Loss of circulation.
3. 10-lb. per gallon mud costs from $1.00 to $3.00 per barrel. 18-lb. per gallon mud costs approximately:
   ——— (a) $5.00 to $8.00, (b) $8.00 to $10.00, (c) $10.00 to $16.00, (d) $30.00 to $40.00.
4. Assume that there are two holes 10,000 ft. deep. Hole 1 is 6 in. in diameter and Hole 2 is 12 in. in diameter. The hydrostatic pressure at the bottom of the hole is:
   ——— (a) Twice as great in Hole 2, (b) The same, (c) Four times as great in Hole 2.
5. The factors that are responsible for swabbing are:
   ——— (a) Rate at which drill pipe is pulled from hole, (b) thickness of mud, (c) Annular space betwen drill pipe and walls of well, (d) All of above.
6. A pocket of gas at a depth of 10,000 ft. will increase how many times when reaching the surface:
   ——— (a) 6 times, (b) 20 times, (c) 100 times, (d) 300 times.
7. A Series 900 blowout-preventer hookup should be tested with the following pressure:
   ——— (a) 5,000 psi., (b) 4,000 psi., (c) 3,000 psi., (d) 2,000 psi.

Write TRUE or FALSE in the blanks provided:

8. ——— It is necessary to install an inside blowout preventer whenever a well kicks.
9. ——— When installing the christmas tree all ring gaskets and grooves should be thoroughly cleaned with a wire brush.
10. ——— The Hydril preventer can completely close off the hole.
11. ——— It is possible to move the pipe with the blowout preventers closed.
12. ——— After the blowout preventer has been made up real tight, it is necessary to periodically make up the bolts again.
13. ——— The pit-level indicator will tell if the hole is taking the right amount of mud.
14. ——— Most blowouts are due to human failures.
15. ——— The mud weight is often increased unnecessarily as a result of swabbed or drill showings.

What is the approximate operating cost of your rig per day? $———.

What is the average cost for drilling and completing a well in the New Orleans area? $———.

What is the hydrostatic pressure at the bottom of a 10,000-ft., 6-in. hole that is filled with fresh water? (Pressure gradient of water—0.433 psi. per ft.)

Quiz No. 2 (Following training program)

Write TRUE or FALSE in the blanks provided:

1. ——— 18-lb. per gallon mud costs approximately $5.00 to $8.00 per barrel.
2. ——— Most blowouts occur when pulling out of the hole.
3. ——— The size of the pipe or hole has no effect on hydrostatic pressure.
4. ——— The correct testing pressure for Series 1500 blowout preventer is 3,000 psi.
5. ——— Speed at which the drill pipe is pulled out of the hole is a factor which affects swabbing.
6. ——— Most of the expansion of gas which is trapped in mud takes place in the bottom section of the hole.
7. ——— The first positive sign that usually indicates that a well is kicking is gas cutting of the mud.
8. ——— There should always be an inside drill-pipe blowout preventer on the rig floor which will fit the drill pipe being used.
9. ——— A wire brush should normally never be used when cleaning ring gaskets and grooves.
10. ——— The Hydril preventer will only close off if drill pipe or the kelly is in the hole.
11. ——— It is possible to move the pipe with the blowout preventer closed.
12. ——— Even if the bolts on the blowout preventers are made tight, they should periodically be checked again.
13. ——— It is possible to add weight material too fast when attempting to control a kick.
14. ——— Most blowouts today are due to present types of blowout equipment being unable to withstand the pressure.
15. ——— It is always necessary to raise the mud weight after a drilled or a swabbed showing of gas.

What is the approximate operating cost of your rig per day? $———.

What is the average cost for drilling and completing a well in the New Orleans area? $———.

What is the hydrostatic pressure at the bottom of a 10,000-ft. hole filled with 10-lb. per gallon mud which has a pressure gradient of 0.52 psi. per foot? ———.

What you should know about DRILLING MUD

A. Density is the weight per unit volume, such as pounds per gallon, pounds per cubic foot, etc. Fresh water has a density or weight of 8.33 lb. per gal. or 62.4 lb. per cu. ft., and a pressure gradient of 0.433 psi. per foot of depth. Clay or shale has a density about 2.6 times that of water and weight material is about 4.3 times that of water. From this, you can see that drilling muds have various weights because they are made up of materials of different weights. Table 1 gives various units that may be used for reporting mud weights.

B. Pressure gradient is the pressure exerted per unit of depth. Pressure gradient of fresh water is 0.433 psi. per foot of depth, and for 10-lb. per gal. mud is 0.52 psi. per foot of depth. To get pressure gradient for any mud weight:

Mud weight in pounds per gallon × 0.052 = pressure gradient in psi. per foot of depth.

Pressure gradient for 16-lb. per gallon mud = 0.052 × 16 = 0.832 psi. per foot.

C. Hydrostatic pressure is pressure due to the density or weight of a column of fluid. This pressure or hydrostatic head exists not only at the bottom of the hole but against the walls of the hole at all points and in all directions. **The hydrostatic head or pressure at any given depth may be calculated by multiplying the pressure gradient by depth.** For example, pressure gradient of fresh water is 0.433 psi. per foot of depth; thus, the hydrostatic head at the bottom of a 5,000-ft. hole filled with fresh water is 5,000 × 0.433 = 2,165 psi. The hydrostatic head at the bottom of this same hole filled with 10-lb. per gallon mud (gradient = 0.52 psi. per foot of depth) would be 5,000 × 0.52 = 2,600 psi. The size or shape of the hole drilled does not have any influence upon the hydrostatic pressure exerted by the mud column as shown by Fig. 1.

D. Normal and abnormal formation-pressure gradients.[1] The fluids or gases in subsurface formations usually exist under pressures corresponding to the height of a column of water from the formation to the surface. Normal-pressure formations have a pressure gradient of from 0.433 (fresh water) to 0.465 (brackish or salty water) psi. per foot of depth. Normal-pressure wells along the Gulf Coast of Texas and Louisiana have a 0.465 psi. per foot of depth gradient. Any well with gradient higher than 0.465 psi. per foot of depth at the oil-water or gas-water interface is abnormally pressured.

E. Overbalance is the pressure differential or safety factor between the mud hydrostatic pressure and the formation pressure. A normal-pressure formation requires a mud weight of 9.0 lb. per gallon to balance it and a mud weight of 9.5 to 10.0 lb. per gallon to drill through it. This extra 0.5 to 1.0 lb. per gallon of mud weight is the overbalance or safety factor required to take care of the reduction in bottom-hole pressure due to swabbing and failure to keep the hole full. In drilling normal-pressure formations, a 10-lb. per gallon mud would result

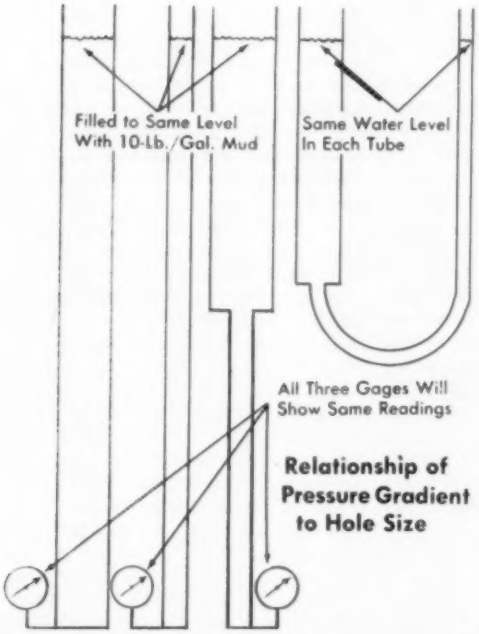

Filled to Same Level With 10-Lb./Gal. Mud
Same Water Level In Each Tube
All Three Gages Will Show Same Readings
Relationship of Pressure Gradient to Hole Size

Fig. 1—Size and shape of hole makes no difference in hydrostatic pressure exerted by mud column.

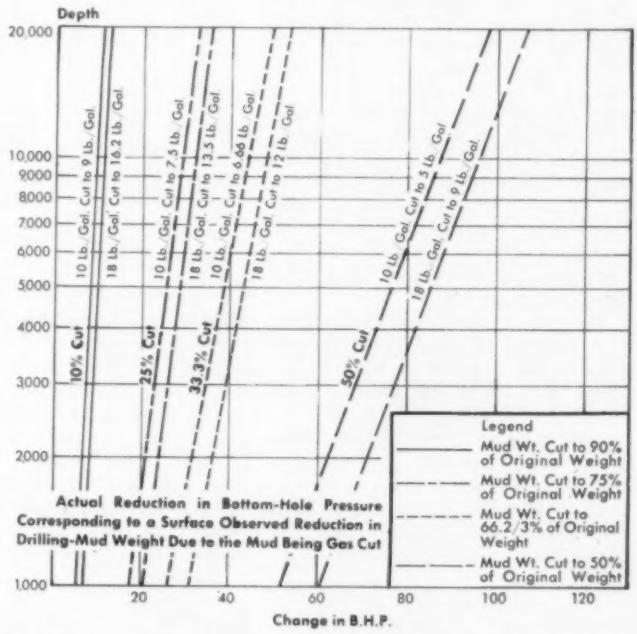


Fig. 2—This graph, based on a modified Strong's equation, shows actual reduction of bottom-hole pressure for drop in mud weight caused by gas cutting.

in an overbalance of 55 psi. at 1,000 ft., 275 psi. at 5,000 ft., and 550 psi. at 10,000 ft.

When drilling abnormal-pressure formations, more overbalance is required than when drilling normal-pressure ones. This extra overbalance is necessary to overcome the increased swabbing action due to drilling a smaller hole and the use of a more viscous mud. An overbalance of 800 to 1,000 psi. is usually maintained when drilling abnormal-pressure formations; however, it can be more or less depending upon hole conditions. Drilling a very small deep hole could require more; whereas, a smaller amount might have to be carried if lost circulation is encountered.

F. Swabbing. When drill pipe is pulled from the hole there is a reduction in hydrostatic pressure, commonly referred to as swabbing. This reduction in hydrostatic pressure at times is sufficient to allow formation fluids to enter the well bore and cause a blowout.

This swabbing action is caused by the adhesion or clinging of the mud particles to the drill pipe, to each other, and to the walls of the hole. When the drill pipe is pulled the mud in contact adheres to it and moves in the direction of movement of the drill pipe. This causes a decrease in the hydrostatic pressure, the amount of which is controlled by the speed of the drill pipe, the viscosity or thickness (gel strength) of the mud, and the annular clearance between the drill pipe and the walls of the hole. The faster the drill-pipe movement, the smaller the annular clearance and the more viscous the mud the greater will be the change in the hydrostatic pressure. In order to determine the actual amount of pressure reduction two Gulf Coast operators have set bottom-hole-pressure gages in the bottom of several cased holes in which drill pipe was pulled and actually measured these reductions.[7,8]

There is a corresponding increase in hydrostatic pressure when the drill pipe is run into the hole. This increase is equal to that due to withdrawal or swabbing.[4] It is often enough to cause lost circulation. This is particularly true with high-weighted muds as they are usually more viscous, annular clearance is smaller, and mud hydrostatic pressure may be nearer the formation breakdown pressure.

It is advisable when drilling abnormal-pressure formations to set large-diameter protective casing to reduce swabbing action and to prevent lost circulation.[3] Use of 9⅝-in. protective casing will usually allow an overbalance of 200 to 600 psi.; whereas, 7-in. casing would require an overbalance of from 800 to 1,400 psi.

The pressure reductions described are due entirely to the withdrawal of a clean string of drill pipe. They should not be confused with the other conception of swabbing, which is the removal of fluid from the hole by a production swab or a balled-up bit or a drill-stem-test packer acting as a swab. Should the bit be plugged or balled up you would have an even greater change in the hydrostatic pressure.

TABLE 1—CONVERSION OF VARIOUS UNITS FOR REPORTING MUD WEIGHTS

Specific gravity	Lb. per cu. ft.	Lb. per gal.	Pressure head per foot depth (psi.)
1.00	62.5	8.34	0.433
1.02		8.5	0.442
1.04	65.0		0.451
1.08	67.5	9.0	0.468
1.12	70.0		0.486
1.14		9.5	0.494
1.16	72.5		0.503
1.20	75.0	10.0	0.520
1.24	77.5		0.537
1.26		10.5	0.546
1.28	80.0		0.555
1.32	82.5	11.0	0.572
1.36	85.0		0.590
1.38		11.5	0.598
1.40	87.5		0.607
1.44	90.0	12.0	0.624
1.48	92.5		0.641
1.50		12.5	0.650
1.52	95.0		0.659
1.56	97.5	13.0	0.676
1.60	100.0		0.694
1.62		13.5	0.702
1.64	102.5		0.711
1.68	105.0	14.0	0.728
1.72	107.5		0.745
1.74		14.5	0.754
1.76	110.0		0.763
1.80	112.5	15.0	0.780
1.84	115.0		0.797
1.86		15.5	0.806
1.88	117.5		0.815
1.92	120.0	16.0	0.832
1.96	122.5		0.850
1.98		16.5	0.858
2.00	125.0		0.867
2.04	127.5	17.0	0.884
2.08	130.0		0.902
2.10		17.5	0.910
2.12	132.5		0.918
2.16	135.0	18.0	0.935
2.20	137.5		0.950
2.22		18.5	0.961

Reproduced from "Principles of Drilling Mud Control," ninth edition.

Two main indications of swabbing are (1) failure of the hole to take mud when making a trip, and (2) gas, oil, or salt-water-cut mud returns from bottom after making a trip.

1. Failure of the hole to take mud when making a trip indicates that formation fluid or gas is entering the bore hole. If enough formation fluid or gas enters the bore hole, hydrostatic mud pressure could be cut enough for the well to kick or blow out. This is a very dangerous type of blowout or kick as it comes when the drill pipe is part way out of the hole. As a result, higher-weight mud is necessary to control it. This type of kick can develop into a blowout as the well may unload for a long time before the kick is discovered. As a result, there may not be much time for closing the blowout preventers, and screwing on the kelly or inside blowout preventer. Since a higher weight mud is required to control the kick or blowout, formations are more likely to break down, resulting in lost circulation. Also surface equipment and casing will be subject to higher pressures.

2. Swabbed showings, commonly called "trip gas," (gas which may be accompanied by oil or salt water) occur in the mud returns from bottom after a trip. They normally last only a short period, a couple of minutes to 20 or 30 minutes. If the showing lasts more than 20 to 30 minutes, it is usually a good practice to raise the mud weight a few tenths of a pound depending upon the intensity of the cutting. However, before raising the mud weight, be sure that the swabbed showings are not results of too viscous mud, a balled-up bit, or pulling the drill pipe too fast. If it was due to any of these, don't raise the mud weight.

G. Drilled showings. When the bit drills a permeable formation, some of the fluids or gases from the chips cut up by the bit will enter the mud stream. And, the mud will be cut or contaminated when it reaches the surface. When you see cut or contaminated mud at the surface, look at the mud pits. If there has been no increase in mud-pit volume, then there is no reason to believe that the well is blowing out. And, there's no need to raise the mud weight. However, if the showing last longer than 25 to 30 minutes and there is a considerable drop in mud weight, you should think about raising the weight a few points. You should also consider making a short trip prior to pulling out of hole.

H. High-pressure shale gas. In

some areas shales contain gas which is under extremely high pressure but apparently of very low volume. After every trip the mud will be gas cut and the longer the drill string is out of the hole usually the more severe will be the gas cutting. If you raise mud weight in trying to stop the shale gas, the usual result is loss of circulation. Best methods of combating this problem are: (1) stay out of the hole as much as possible; (2) use a mud degasser; and (3) keep a low-viscosity, low-gel mud that cuts down swabbing and permits degassing at the surface.

From this you can see it does not mean that a well is going to blow out just because mud at the surface is gas cut. Rather it should be taken as a caution signal. The main thing which tells that a well is kicking is an increase in the mud volume as shown by an increase in mud-pit level. If a well is kicking, the increase in mud volume will begin before the showing of gas, oil, or salt water reaches the surface. If there is an increase in pit level, close the blowout preventer immediately and start getting the well under control.

Mud weight is often raised unnecessarily because of swabbed or drilled showings. Gas cutting, as shown by a drop in mud weight at the flow line, takes place in the top few feet of the mud column; it reduces bottom-hole hydrostatic mud pressure very little.

Take a single bubble of gas in a 10-lb. per gallon mud at 10,000 ft. that is being pumped upward. The bubble will have doubled its volume at 5,000 ft., increased four times in size when it reaches 2,500 ft., 16 times when at 625 ft., 78 times at 100.0 ft., and 354.5 times when it has reached the surface.

Fig. 2 is based upon a modified Strong equation.[5] It shows the actual reduction in the bottom-hole pressure for any drop in mud weight you measure at the surface when the mud is gas cut. You can see from this figure a big drop in surface mud weight reduces the bottom-hole pressure by only a few psi. For example: An 18-lb. per gallon mud cut to 9.0 lb. per gallon would give a bottom-hole-pressure reduction of only 94.8 psi. at 10,000 ft. This is not very much.

To judge how bad a swabbed or drilled showing is, weigh the mud every 2 to 5 minutes until the showing clears up. Make a chloride-content determination of the filtrate from the lowest weight mud recorded during the showing. Be sure to mark on the tour sheet how long mud weight was cut, how low it got, and what the chloride content was.

I. Loss of circulation. Loss of circulation does not mean that a well will kick or blowout. It does mean, however, that you must pay attention to level of mud in the annulus. In abnormally high-pressure formations it is a good practice to keep the annulus full even if you have to use water. If the mud in the annulus falls far enough to allow the well to kick, close the blowout preventers immediately to bring the well under control. If necessary, start adding lost-circulation material, but try not to raise the mud weight.

Occasionally when drilling with high-weighted muds, the well will flow back for a short time after the pumps are shut down. Usually this is caused by an unequalized mud column. Or it may be merely the return of mud lost or injected previously into a formation.

There are two general types of "KICKS" OR BLOWOUTS

WHENEVER hydrostatic pressure of mud in the hole is less than pressures of the exposed formations, we have a "kick." A blowout is an uncontrolled kick. In general, there are two types of kicks or blowouts:

A. Blowouts from shallow normal-pressure sands.

Along the Gulf Coast of Louisiana and Texas, there are shallow normal-pressure gas sands having pressure gradients of 0.44 to 0.465 psi. per foot of depth.[1] Low-weight mud columns of 8.4 to 8.9 lb. per gallon will balance these normal-pressure formations, and low-gel-strength muds of 9.6 to 9.8 lb. per gallon will safely drill them.

However, if the hydrostatic mud pressure is not carefully kept higher than the formation pressure, these normal-pressure sands will blow out the same as abnormal-pressure ones. Usually, normal-pressure formations blow out because of a combination of: (1) failure to fill the hole; and (2) allowing gel strength and viscosity of the mud to get high enough to swab the well in. Both are serious since only a small overbalance is normally carried at shallow depths.

In rare instances, a casing leak or a blowout will charge some of the shallow, usually normal-pressure sands. These charged sands may have extremely high pressure for such shallow depths. As a result they may be very difficult to drill and control.

B. Abnormal or high-pressure blowouts.

An abnormal pressure is one which, at the oil-water or gas-water interface, has a pressure gradient higher than 0.465 psi. per ft. of depth. Or, it is one which exceeds the hydrostatic pressure of a column of salt water containing 80,000 p.p.m. total solids. Abnormal pressure reservoirs are not limited to any particular locality. Deeper drilling has found them in many parts of the world.

Along the Gulf of Mexico there are many wells containing abnormal-pressure reservoirs. These wells are widely distributed in a belt 50 to 75 miles inland to as much as 65 miles offshore from the Rio Grande on the southwest, to the Mississippi Delta in the east. These abnormally high-pressure wells have pressure gradients that range from only slightly above normal to almost 0.90 psi. per foot of depth.

Fig. 3 shows the pressure gradient in a number of abnormal-pressure wells in Louisiana and Texas. As the figure shows, these abnormally high-pressure zones usually lie below 7,000 ft. And the change from normal to abnormal pressures comes abruptly over a short vertical distance.

Highest abnormal pressure you can expect should not be more than about

Table 2–Occurrences, Warning Signs, and the

OCCURRENCES	WARNING SIGNS	CAUSES	ACTION TO TAKE
NORMAL-PRESSURE FORMATIONS			
WHEN DRILLING	Increase in mud pit volume.	Drilling fluid too light.	Close blowout preventer and increase mud weight.
	Loss of Circulation.	Drilling fluid too heavy and/or improper drilling techniques, i.e., spudding of drill pipe with pump on, etc.	Observe fluid level in annulus to insure that well is not kicking. If well kicks, close blowout preventer and add lost-circulation material to mud. Increase mud weight only if necessary.
	Gas, oil, or salt water cut mud.	Swabbing or drilled show.	Condition mud, and increase mud weight only if showing was of sufficient intensity to warrant doing so.
	Increase in pump speed or decrease in pump pressure.	Mud too light or hole in drill pipe.	Observe mud-pit level, if increase in level obtained, close blowout preventer and raise the mud weight. If no increase in mud-pit level, check for hole in drill pipe.
WHEN MAKING TRIP	Increase in mud pit volume or well beginning to flow back.	Failure to fill hole and/or swabbing.	Attempt to run drill pipe as near back to bottom as safety and time will permit. Close blowout preventer. Circulate and condition mud, increasing mud weight only if necessary.
	Hole fails to take mud when filling up.	Swabbing.	Do not pull any more drill pipe, but go back to bottom and condition mud. Lower gels and viscosity if high. Close blowout preventer and put on choke if necessary.
	Loss of circulation-unable to fill hole.	Running drill pipe in hole too fast, spudding drill pipe.	If unable to fill hole after wating several hours, add lost-circulation material to mud system. Pay particular attention to mud in annulus to insure that well is not kicking.
WHEN OUT OF HOLE	Well begins to flow back-increase in pit level.	Failure to fill hole and/or swabbing.	Attempt to run drill pipe as near back to bottom as safety and time will permit. Circulate and condition mud. Close blowout preventer and put on choke, if necessary, and increase mud weight only if necessary.
ABNORMAL PRESSURE FORMATIONS			
WHEN DRILLING	Increase in mud pit volume.	Drilling mud too light.	Close blowout preventer and increase mud weight.
	Gas, oil, or salt water cut mud.	Swabbing or drilled show.	Lower viscosity and gel strength of mud if high. Increase mud weight only if showing was of sufficient intensity to warrant doing so.
	Loss of Circulation.	Drilling mud too heavy and/or poor drilling techniques.	Attempt to keep annulus full using water, if necessary. Watch annulus and should well kick, close blowout preventer. Add lost-circulation material to mud system and regain returns. Increase mud weight only if necessary.

Action to Take When a Kick Is Encountered

OCCURRENCES	WARNING SIGNS	CAUSES	ACTION TO TAKE
ABNORMAL PRESSURE FORMATIONS			
WHEN MAKING TRIP	Increase in pump speed or decrease in pump pressure	Drilling mud too light or hole in drill pipe.	Observe mud-pit level, if increase is obtained, close blowout preventer and increase mud weight. If no increase in mud-pit level, check for hole in drill pipe.
	Drilling break.	Drilled into porous formation.	Observe mud pit level, if increase is obtained, close blowout preventer and increase mud weight. Circulate returns up from bottom mud and, if showing of gas, oil or salt water is of sufficient intensity, increase the mud weight.
	Hole fails to take mud when filling up.	Swabbing.	Attempt to run drill pipe as near back to bottom as time will permit. Circulate and condition mud. Close blowout preventer and put through choke, if necessary; increase mud weight only if necessary.
	Well begins to flow back-increase in mud pit level.	Swabbing and/or failure to fill hole.	Attempt to get drill pipe as near back to bottom as safety and time will permit. Close blowout preventer. Circulate and condition mud, increase mud weight only if necessary.
	Loss of Circulation-unable to fill hole.	Running drill pipe in too fast, spudding drill pipe.	Attempt to keep annulus full using water, if necessary. Watch annulus and should well kick, close blowout preventer. Add lost-circulation material to mud system and regain returns. Increase mud weight only if necessary.
WHEN OUT OF HOLE	Well begins to flow back-increase in mud pit level.	Swabbing and/or failure to fill hole.	Attempt to run drill pipe as near back to bottom as safety and time permit. Circulate and condition mud. Close blowout preventer and put through choke, if necessary; increase mud weight only if necessary.
COMPLETING			
WHEN RUNNING CASING	Loss of circulation.	Running casing in hole too fast.	Procedure to follow will depend upon the conditions existing at time of losing circulation. In general, annulus should be kept full even to the extent of filling up with water in order to observe if well is kicking.
	Well begins to flow back.	Swabbing on previous trip.	If possible, and safety and time permit, continue to run casing to bottom. Close blowout preventer and put through choke, circulate and condition mud raising mud weight only if necessary.
WHEN TESTING	Well begins to flow back-increase in mud pit level.	Completion fluid too light or well swabbed in when pulling completion tools or DST tool.	Kill well by pumping into it or by circulating and increasing weight of completion fluid.
INSTALLING XMAS TREE.	Leak around fittings.	Improper installation and tightening of fittings, use of low pressure fittings.	First determine if fittings may be tightened or replaced, or if well must be killed. If in doubt, kill well. Do not take any chances.
AFTER COMPLETING	Excessive pressure or annuluses.	Leak in tubing or casing.	Kill well and then make the necessary repairs.

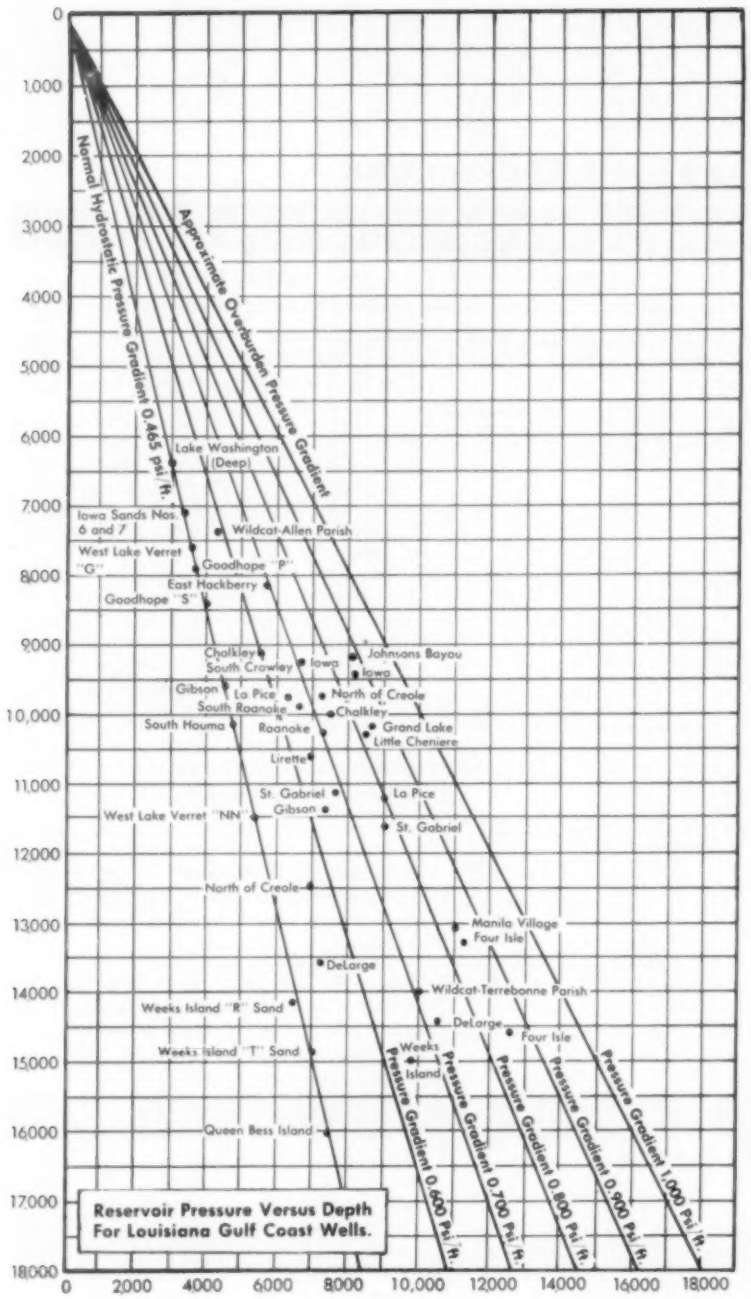


Fig. 3—There are many abnormal-pressure wells along the Gulf Coast, offshore and on, from the Rio Grande to the Mississippi. Almost all lie below 7,000 ft. This chart taken from G. Dickinson, A.A.P.G. 37 (2), February 1953.

90 per cent of overburden pressure. Overburden pressure is the pressure due to the weight of the earth or overburden.[3] For all practical purposes, it is 1 psi. per foot of depth. Based upon this, a 17.3-lb. per gallon mud would balance any abnormal pressure. And, usually, an 18-lb. per gallon mud should properly control it for drilling.

Many insist that higher pressure gradients must exist; they have seen apparent flows or attempts to flow by wells using mud weights in excess of 18.0 lb. per gallon. However, the reason for these flows is likely an unequalized mud column. Cause of the unequalized column may be gas cutting or spotty mud weights or merely the return of mud which has been lost or injected into the formation.[1]

What Causes BLOWOUTS?

MOST PEOPLE, when they hear the word "blowout," think of the bit drilling an abnormal-pressure zone with too light a mud. This is usually the wrong conclusion to make for these reasons:

1. More than 50 per cent of all blowouts are on wells with only normal-pressure formations. And, at the time of the blowout, the weight of the mud in use was heavy enough to control normal-pressure formations.

2. Most blowouts occur while a trip is being made.

A study was made of 55 well blowouts over a 10-year period (1940-49 inclusive) in California.[6] It gave the following primary causes for the wells blowing out.

Causes—	Per cent of total
1. Failure to keep hole full of fluid	42
2. Insufficient drilling fluid density	15
3. Reduction in static pressure by drill pipe withdrawal, swabbing	16
4. Reduction in fluid level by lost circulation. Probably failure to fill hole and swabbing well in, rather than lost circulation	22

This same study showed that after the wells kicked they could not be controlled because:

Causes—	Per cent of total*
Insufficient blowout equipment	29
Improperly designed blowout equipment	5
Improper installation	11
Improper surface fittings	6
Improper well-casing program and cementing practice	11

*Blowout-control equipment worked satisfactorily or was not required on 20 of the blowouts, 36 per cent of those studied.

This record shows that men involved in drilling the wells were directly responsible for 60 per cent of the blowouts because of their actions or because they did not think. Today the percentage of blowouts due to human failure is probably greater as there have been vast improvements in blowout preventer equipment since the period covered by this report.

M. R. Jones, of Cameron Iron Works, Inc.,* reported the following:

"In our observation of our customer's experiences, we think that 95 per cent of the wells which get away

*Written communication.

do so as the result of two things. First, poor maintenance and inadequate testing programs result in leaks which cut out the assembly; and, second, inadequate crew training results in nonuse or misuse of equipment."

A. Gas cutting not a cause . . . Gas cutting has not been cited as a cause of blowouts. Reason for this is that almost all the effect of gas in reducing hydrostatic pressure takes place in the top few feet of a mud column. If there has been no rise in pit level before gas appears at the flow line, no blowout is threatened. And the gas should be considered only a warning to the driller to check over everything.

Any blowout attributed to gas cutting, you can be sure, is actually the result of several days of gas cutting and careless handling of the well. For if there is an actual flow, you will know it by an increase in the mud-pit volume. Several minutes to hours may pass before any gas-cut mud comes to the surface. For this reason it is important to keep a constant careful check on the mud volume. An increase in the mud pit level is usually the first and most positive indication that a well is kicking.

B. Watch for warning signs . . . Table 2 lists the warning signs, causes and the action to take when there is a kick. As we said before, more than half of all blowouts have occurred while drilling normal-pressure wells. Also, probably 80 per cent or more of these blowouts come while making a trip and are the result of two things: (1) failure to keep the hole filled up, and (2) swabbing.

How to get the well under CONTROL

THESE are the things you should do when the well is kicking:

A. While drilling

1. Pick up drill pipe far enough that the blowout preventers can be closed on the drill pipe instead of the kelly.

2. Close the annular-type preventer on the drill pipe. If necessary, close the flow-line valve so that the mud returns will be put through the choke manifold. Fig. 4 shows a basic blowout-preventer assembly. Fig. 5 is an optional arrangement. The normal and correct thing is to keep the choke manifold open at all times when drilling or making a trip. It should be set up so that when the annular-type preventer is closed, mud can be immediately circulated through a 2-in. line, a 1-in. choke, or both. If a valve is closed between the preventers and the choke manifold, it should be opened prior to closing the annular-type preventer. Use large chokes at first. This prevents putting so much back pressure on the well that circulation is lost or that surface equipment fails.

3. Keep circulating; do not shut down the mud pump. However, it is usually best to slow down the mud pump at first so as not to put too much pressure on the exposed formations, surface fittings, and casing.

4. Watch mud-pit level and regulate flow of mud so that the amount of mud coming out of the hole is equal that being pumped in. If neces-

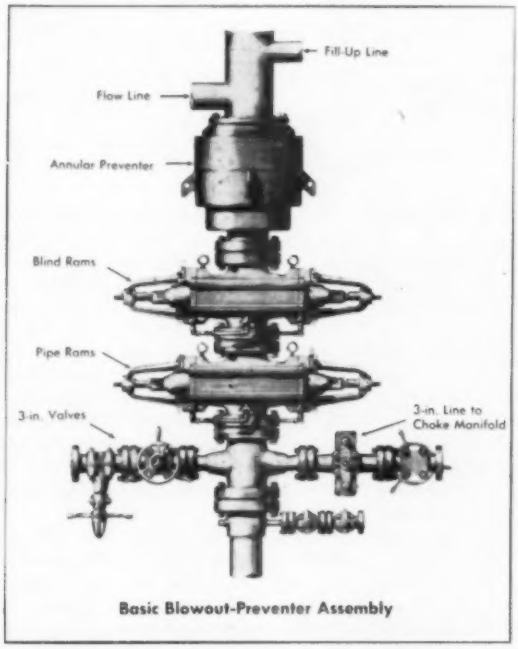


Fig. 4—Basic blowout-preventer assembly. Spools and preventers should be Series 1500 for high-pressure and offshore areas; for normal-pressure areas, they can be Series 900.

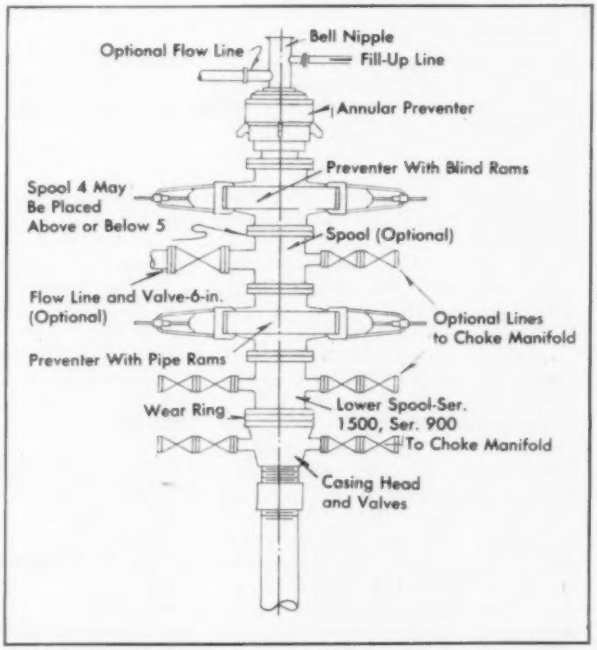


Fig. 5—An optional blowout-preventer assembly. As with the assembly in Fig. 4, spools and preventers shou'd be Series 1500 for high-pressure and offshore areas, Series 900 for normal areas.

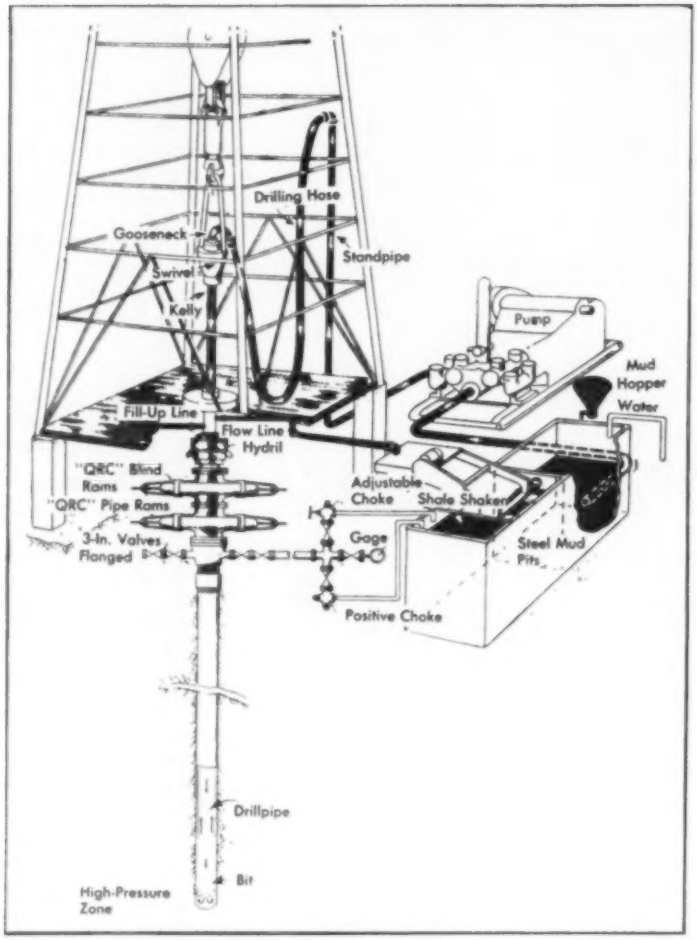


Fig. 6—For practical purposes, the drilling-mud system is closed. If there's an increase in the system, it comes from adding materials at the surface or from fluids and gas from the formations in the well.

sary, change choke bean sizes and speed of the pump. The mud-pit level should only increase in volume an amount equivalent to the volume of weight material and water being added. Try to maintain the same rate of circulation as when drilling.

As Fig. 6 shows, the drilling-mud system for all practical purposes is closed. An increase in the system comes either from adding water or mud materials at the surface or from fluids, or gas from the exposed formations entering the hole. From this you can see that, if the mud-pit level remains constant the well is under control. All that needs to be done is to raise mud weight enough that you don't have to hold back pressure with the chokes and an additional amount sufficient to give enough overbalance to make trips safely.

5. Raise the mud weight, by adding weight material. Even though the kick is a strong one, don't start mixing the weight material faster than 4 to 8 sacks per minute. Reason is that at rates of 10 sacks or more per minute, mud weight going into the hole will be 20 to 28 lb. per gallon. This high weight will generally break the formation down and cause loss of circulation. Adding 100 sacks of weight material should raise mud volume 6.64 bbl.

Whenever the well has been choked back so that the mud-pit level remains constant, the well for all practicable purposes is under control. All that remains is to raise the weight and condition the mud until it is safe to make a trip. You can get an idea of how much mud weight will have to be raised from the amount of back pressure it is necessary to hold at the surface. It is best not to raise the mud weight too fast. Do it gradually and thus prevent breaking down the shallower formations and losing circulation.

6. Add lime, if a lime mud is being used. Try to put in one 50-lb. sack of lime for each 15 sacks of weight material added. If the lime thickens the mud, reduce the rate of adding the lime until you get only a small amount of thickening or viscosity increase. Adding the lime is necessary as the addition of weight material may reduce the lime content below the correct level.

7. Add caustic and thinner to any viscous salt-water-cut mud. Discard badly contaminated mud if it can be replaced by reserve mud of the correct weight.

8. Degas any gas-cut mud which appears at the surface. Start putting the mud through the degasser; or release the entrained gas by running the mud in the pits.

9. Rotate the drill pipe and occasionally move it up and down to keep it from sticking.

10. Close the ram-type preventers on the drill pipe if the annular-type preventer rubbers show signs of wearing out. If the well is at its worst with high pressures on the annulus, it would be advisable not to move the drill pipe. You may let the pipe stick but there's less chance of the well blowing wild. If the annular-type rubber wears out, close the bottom ram-type preventer. Remove the blind rams in the upper one and replace them with pipe rams which will fit the drill pipe in use. After installing the pipe rams in the upper preventer, close them on the drill pipe. Then open the bottom preventer and start moving the drill pipe if it is not stuck.

11. Protect the blowout-preventer rubbers when moving and rotating the drill pipe by running a small stream of water on them. Also, use the regulator valve on the blowout-preventer control manifold to reduce the hydraulic fluid pressure on the rubber or rams to a point where wellbore fluid just barely leaks through. The leakage of fluid tells you the pressure on the rubbers is low enough to reduce wear. Also, the fluid helps to lubricate them and thus prolong their life.

12. Keep increasing size of the chokes as back pressure falls; the falling pressure shows the well is being brought under control. The larger chokes decrease the amount of hydrostatic pressure on the casing and exposed formation. When increasing the size of the chokes, be sure the mud

Fig. 7—Even if the kick is a strong one, don't add weight material faster than four to eight sacks per minute. There's too much danger of loss of circulation.

Fig. 8—When the well kicks, get more weight material, cement, and high-pressure pumping equipment on the way. If you don't use them, their cost is still good insurance.

level in the pits remains constant. If pit level increases, you must either raise the pump speed or decrease size of the chokes. It is essential that the mud level in the pits remain constant except for the increase in volume resulting from weight material or water being added.

13. Do not close a well completely in, unless absolutely essential. Closing a well completely in puts undue pressure on the casing and exposed formation. The result is often stuck drill pipe.

14. Get bore weighting material, cement and high-pressure pumping equipment on the way when the well begins to kick. If you never use them, their cost is very little compared to the safety of having them on hand.

15. Check for leaks in the blowout-preventer assembly as soon as you have closed the annular-type preventer. By catching the leaks early, you may be able to repair them before they cut out too much and cause a blowout.

16. Regain lost circulation if it occurs. This can sometimes be done by slowing down the pumps, reducing the circulating rate, and at the same time holding the mud-pit level constant by changing choke sizes.

B. When making a trip

1. Get drill pipe back into the hole as far as safety and time will permit. The more pipe you have in the hole the lower will be the mud weight required to bring it under control.

2. Lower the pipe back to the top of the rotary and set the slips if the well is kicking too hard to run the drill pipe back into the hole.

3. Screw on the kelly. If the well is flowing back through the drill pipe too hard to put on the kelly, install the inside drill-pipe blowout preventer. After installing the inside blowout preventer, screw on the kelly.

4. Close the annular-type preventer. If there is not much drill pipe in the hole, also close the ram-type preventer. This will prevent dropping the drill pipe should the slips loosen. It will also prevent the drill pipe from being blown out of the hole.

5. Proceed to get the well under control as shown under "While Drilling."

How to PREVENT blowouts

AS WE'VE said, the reason for most blowouts is human failure. This can be boiled down to men on the rig not recognizing when a well is kicking or, if they recognize it, not doing something to correct it.

A crew must be alert and know the signs indicating that a well is kicking. They must then immediately close the blowout preventers and start getting the well under control. **The blowout preventers should be used as preventers and not as stoppers.** Don't believe that closing the preventers on the drill pipe will prevent moving it and cause it to stick. With today's blowout preventers, you can reciprocate and rotate the drill pipe when they are closed.

Some of the things which help prevent blowouts are:

1. Keep the hole full of mud at all times. Check the mud-pit level and the mud returns frequently to see that there has been no change.

2. When making a trip watch the pit-level indicator. It will tell you if the hole is taking or displacing the right amount of mud. Know exactly how much the hole should take for each stand of drill pipe withdrawn or run in.

Should the hole fail to take the right amount of mud when coming out, go back to bottom. Circulate returns up from bottom and see how badly gas, salt-water, or oil-cut the returns are. Then you can decide if the mud weight should be raised or if the mud only needs conditioning and then drill pipe withdrawn slower to reduce the swabbing. Table 3 shows capacity and displacement of different sizes of drill pipe.

3. Keep the mud in good condition. That is, equalize weight and viscosity; keep a good gel strength to prevent swabbing. One way to keep mud

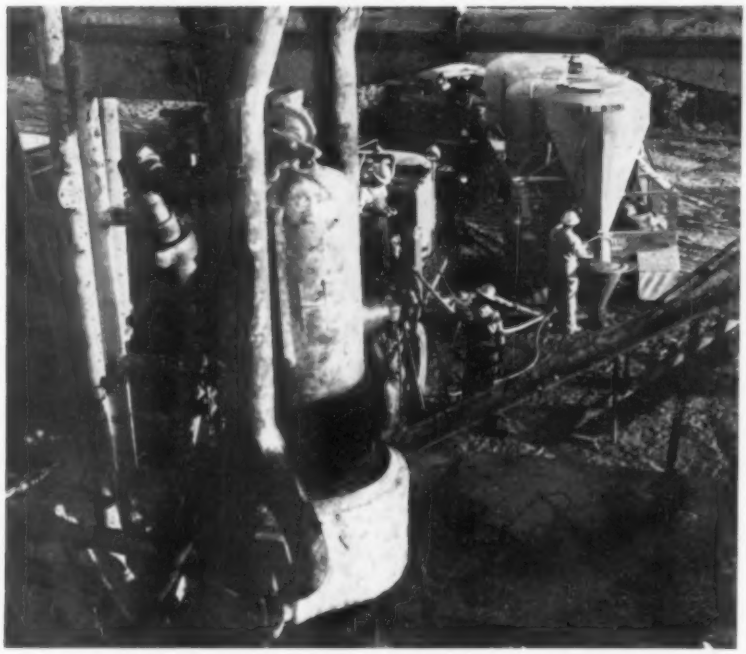


Fig. 9—If you lost returns while cementing the oil string and the annulus doesn't stand full, fill it with mud or water. Make sure the well is dead before removing blowout preventers.

TABLE 3—CAPACITY AND DISPLACEMENT OF DRILL PIPE

Size o.d.-in.	Size i.d.-in.	Weight Lb./Ft.	Capacity Bbl./100 ft.	Displacement Bbl./100 ft.	Displacement Bbl./90 ft. stand
2⅜	2.151	10.40	0.45	0.40	.36
3½	2.764	13.30	0.74	0.51	.46
4½	3.826	16.60	1.42	0.64	.58
5⅛	4.859	22.20	2.29	0.87	.78

equalized is to make all mud and chemical additions over a period of at least one complete circulation and possibly two.

4. When drilling in an abnormal or high-pressure zone, run and pull the drill pipe at reduced speed. This will reduce swabbing action and prevent loss of circulation.

5. Drill pipe should not be spudded. This is especially true with the mud pumps running; this puts undue pressure on the exposed formations.

6. Circulation should be broken at reduced pump pressure in order to prevent loss of circulation. The possibility of losing circulation is always present when using high-weighted muds. Often it is easier to overcome a kicking well than it is to restore loss of circulation.

7. A drilling break, of course, indicates a permeable zone. If you get one while drilling a wildcat well or in known abnormal pressure zones, it is advisable to pick up and circulate returns up from the bottom. After picking up off bottom, watch the mud-pit volume carefully to see you are getting no increase which would indicate that the well is kicking. If mud volume increases, immediately close the annular-type preventer and start getting the well under control.

8. Before making a trip when drilling in abnormal-pressure formations, it's a good idea to make a short trip.

Fig. 10—Use a high-pressure master valve on top of the tubing or drill pipe when drill-stem testing. It can be closed if pressure gets too high.

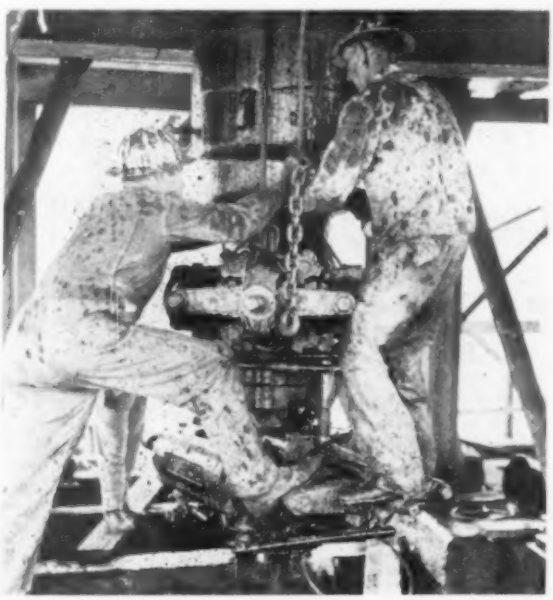


Fig. 11—When removing the blowout preventers and installing the tree, close the rams in the tubing head. Install a back pressure valve in the tubing also.

This is especially important if you have had drilled showings or if you've had to raise mud weight to overcome a kick. A short trip means pulling 6 to 10 stands at normal rate, watching for swabbing, and then running back to bottom. When you circulate bottoms up, you can see how badly returns off bottom are cut by gas, oil, or salt water. If there is swabbing or if returns are badly cut for more than 30 minutes, you should think about increasing mud weight. Then, possibly you might make another short trip before coming out of the hole.

9. When completing a well, try at all times to have some type of control equipment on the well so it can be safely closed in. About the only time that this is not possible is when installing the tubing head and nippling up the blowout preventers to be used during completion.

10. Before taking off the blowout preventers used while drilling, note the mud in the annulus between the protective string and the oil string. Make sure that the well is dead and that mud is not flowing back. If you lost returns while cementing the oil string and the annulus does not stand full, fill it with mud or water. Watch to make sure that the well is dead before blowout preventers are removed.

11. When running or pulling tubing, keep a high-pressure valve handy. This valve should have the proper threaded connections to allow screwing it onto the tubing if the well starts to unload.

1. When installing the christmas tree be sure to carefully clean and inspect all ring gaskets and grooves. Try not to use a steel brush or abrasive material.

13. There are some points which will help prevent blowouts during drill-stem testing:

(a) Keep the casing full of fluid at all times.

(b) When pulling the drill-stem-test tool be sure to see that the hole is taking fluid and is not swabbing.

(c) Use a reversing tool so that the fluid in the tubing or drill pipe above the tool after test can be reversed out.

(d) Be sure to check the blowout preventers to see that they will shut off around the tubing or drill pipe you are using. Do this before you open the drill-stem-test tool.

(e) Install a high-pressure master valve on top of the tubing or drill pipe. It can be used to shut off the drill pipe or tubing if the pressure gets too high.

(f) The choke in the drill-stem-test tool should be small enough to prevent abnormally high flowing tubing pressure.

(g) If possible, the surface choke manifold should be above the master valve on the tubing or drill pipe. This will cut down on the fittings and pipe subjected to high pressure.

(h) The well should be opened on a small surface choke. Choke size should be increased only after you can see how high pressured the well is.

14. When removing the blowout preventers and installing the christmas tree, or vice versa, the rams in the tubing head should be closed on the tubing and a back pressure valve installed in the tubing. This will completely close the well in.

15. When perforating or running tools on wire line be sure that a lubricating head is correctly installed. Of course, it must be of the proper pressure rating and big enough to handle the tool being run.

16. When moving a rig off a well after completion be sure that the christmas tree and wellhead connections are protected. Falling objects can break off a connection or a line and cause a blowout. The same applies when moving onto a well for a workover or completion.

17. Have an inside blowout preventer on the derrick floor at all times. It must fit the drill pipe in use. In case the well kicks through the inside of the drill pipe when making a trip, the inside preventer can be put on and the drill pipe closed off.

If you have more than one type of drill pipe in the string, break out the changeover sub or subs and leave them on the derrick floor when making a trip. This is necessary so the kelly or the inside blowout preventer can be screwed onto whatever make of drill pipe is in the hole at the time a kick starts. Otherwise the changeover sub would be on pipe standing in the derrick; and it would be impossible—or at least take a long time—to get the kelly or inside blowout preventer put on.

18. Make periodic checks of the bolts in the blowout preventer assembly to insure that they are tight. Often after an assembly is made up with the bolts tight and properly tested, vibration of the rig and the drilling string will loosen the bolts. In fact, this has probably caused many blowouts.

19. Use double "O" safety seal rings on the inside and outside of the steel gaskets between flanges. The rings insure against leaks. The rubber safety seal rings prevent corrosion and wear of the metal seal rings. Also, the inside seal ring will act as an O-ring and seal off against pressure if the metal ring fails to hold.

0. Catching samples is very important when you are in an area where you may drill abnormal pressures. Reason is that the samples can tell you which geologic section or age sediments you are drilling. Knowing this and checking with nearby wells you can often determine where to expect abnormal pressures. This prevents drilling into abnormal-pressure zones with mud weight too low. Sample information will also help in picking the depth to set protective casing.

BLOWOUT! What to do about it

A. Barite plugs[1]

Occasionally, a well kicks when only surface casing has been set. Often in these cases, mud weight required to control the kick is greater than the exposed shallow formations will support. Loss of circulation results. Adding lost-circulation material usually will not restore circulation. So, it is necessary to kill the flow at bottom. This can be done sometimes by the use of a barite plug. A barite plug is a barite-water slurry weighing about 22 lb. per gallon. Amount of barite plug to use should be calculated as when setting a cement plug, and a cement mixing truck used for mixing and displacing the plug.

The barite plug has advantage over a cement plug. With the barite there is less chance of sticking the drill pipe. Moreover, the barites will usually settle and set up even though fluid would be entering sufficiently to prevent cement from setting up. Due to its higher specific gravity, the barite plug has a pressure differential of about 0.35 psi. per foot greater than a cement plug.

B. Cement plugs

Quite often when a well is kicking or blowing out, the hole will bridge

Fig. 12—Rarely is it necessary to let a well blow wild. If it is necessary, try to prevent fire and protect the blowout preventers and wellhead fittings.

over and the drill pipe will stick. After the pipe sticks it is sometimes advisable to set a cement plug in order to bring the well under control. Setting of a cement plug will allow:

1. Backing off and recovering some of the drill string.

2. Possible setting of a protective string of casing near the top of the abnormally pressured zone.

3. Safer conditions for such work in the hole as washing over, converting to a lime-base mud, running a string shot, and backing off.

4. Plugging and abandoning the well.

These things will help when setting cement plugs:

1. Occasionally, fluid movement will prevent the cement plug from setting up. One way to set a plug under these circumstances is to precede the cement plug with a Cal-seal plug. Before using Cal-seal, check its setting time with the mixing water you will use to make sure there's enough setting time. Example: 50 sacks of Cal-seal followed by 50 to 100 sacks of cement, the two separated by 5 bbl. of water.

2. When setting a cement plug, use a little excess cement to allow for some contamination with mud. Also, a good idea is to use either a few barrels of water or straight gel mud containing no chemicals ahead of the cement. This will prevent the chemically treated mud from contaminating the cement.

3. For some slow-set cements to develop any strength at shallow depth, 6,000 to 10,000 ft., it is necessary to allow at least 24 hours WOC time.

C. Reverse circulation

There are advantages to using reverse circulation to control a kick. These are:

1. The mud in the annulus does not become contaminated; therefore, the walls or sides of the hole should stay in better condition.

2. Usually there is less pressure on the surface equipment (preventers and casing). This is because nothing but the drill pipe and choke manifold should be subjected to the high pressure.

This method is good for controlling a kick if you have the following set of circumstances:

1. Hole condition is good. The hole should not be likely to slough and let pieces of shale fall in and stick the drill pipe or plug the bit. Usually, you'll have such good hole condition only when there is a small amount of open hole.

2. The bit being used has large jets or circulating ports. They should be ⅜ in. or larger to prevent plugging.

3. The drill string is not small. If the pipe is 3½ in. or 2⅞ in., you will need much more pressure to circulate. As a result, lost circulation is more likely.

4. To reverse circulate, you must be rigged up so the contaminated mud can be chemically treated, degassed and weight raised, if necessary, before pumping it back into the well.

5. Exposed formations should be strong enough to withstand the additional pressure. Reverse circulation can cause weak zones to break down, causing loss of circulation.

6. When reverse circulating there is a good possibility of fluid cutting the drill pipe. The danger is greatest when the stream into the annulus is high pressure, the mud contains sand, and the pipe cannot be moved.

D. When to let a well blow wild

Rarely is it necessary to let a well blow wild. But sometimes it is. Take the case when you drill into an abnormal-pressure zone with no protective casing set. And, after you close the preventers, mud starts boiling up outside the surface casing. This means the high-pressure flow has started out around the surface pipe. In this case the best thing to do would be to open the well up and let it blow wild, hoping that it bridges over and kills itself. Otherwise, the well may crater and you will lose the rig.

Occasionally, after you close the blowout preventer, a valve or fitting may be cut out. Or, it may not be made up tight enough. Because of the high-pressure flow through the leak, it may be impossible to get in to make it up tight or replace it. By letting the well blow wild or uncontrolled for a short time, you take the high pressure off the wellhead assembly. Then, it may be possible to replace the fitting or make it up tight.

If a well blows wild (or if it is necessary to let it blow wild) here are some important pointers:

1. If you are using a drilling barge, try to pull the rat hole, float the barge and move back off the well.

2. Try to prevent the well from catching on fire by shutting down motors, putting out fires, etc.

3. Protect blowout preventers as much as possible; (a) put water on them to keep them cool, (b) keep fire or burning oil away from them.

4. Protect fittings on wellhead. Later on it may be possible to connect on to them to kill the well.

5. If protective casing has been set, try to pump annulus between it and the surface casing full of cement.

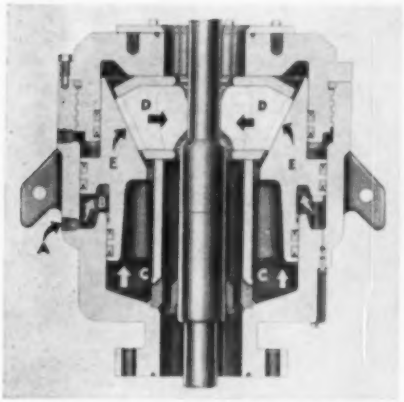


Fig. 13—The annular preventer. With no change of parts, it can seal around any shape or size member of the drill stem.

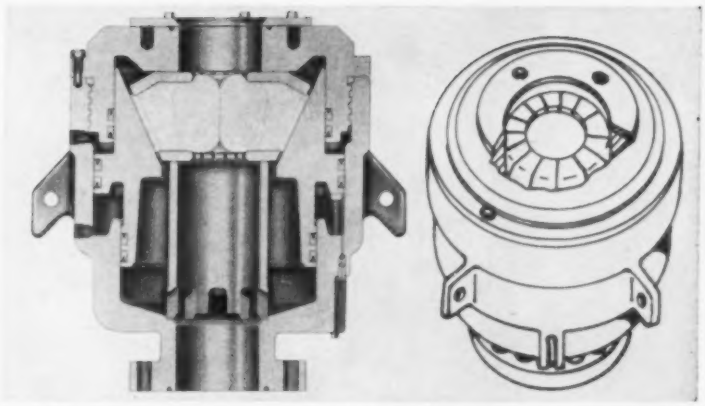


Fig. 14—This preventer will close off against open hole. However, repeatedly doing this shortens the life of the cartridge-type packing. So, close off against open hole only in emergencies.

The kinds of BLOWOUT PREVENTERS

THERE are two general types of blowout preventers: (1) the type which will shut off around any type of drill string which is in the hole or the open hole; and, (2) the ram type which has either blank rams to shut off the open hole or rams of a specific size which will shut off only on a single size drill string.

A. Annular preventer. This blowout preventer with no change of parts can seal around any shape or size member of the drill stem. This includes all sizes of drill pipe, drill collars, and tool joints as well as square or hexagonal kellies. The preventer also acts as a master valve since it will pack-off the open hole.

The annular preventer is usually the first closed in case of a kick. Reason is that it is the top preventer. Also, it is the most flexible one since, when closed, it will allow the pipe to be rotated, reciprocated, and stripped out under pressure.

Essentially, the annular preventer is made up of four parts; the body, the contractor piston, the head, and the cartridge-type rubber packing unit. All are shown on Fig. 13.

The cartridge-type packing unit is not only easy to change but also has remarkable ability to hold pressure. The packing unit is composed of high-tensile-strength rubber packing material molded around a series of flanged metal ribs. The preventer is made so that well pressure imparts an additional closing force. And, as well pressure increases, less outside pressure is required to maintain the pack-off.

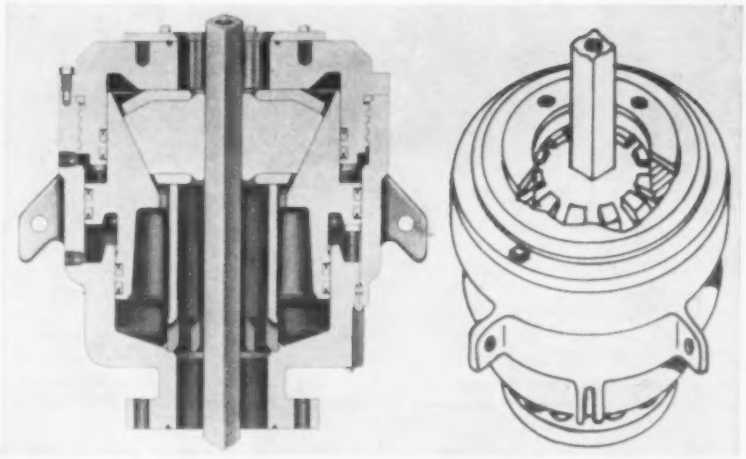


Fig. 15—While the annular preventer will close off against square or hex kellies, they should not be rotated within the closed packing unit.

If you repeatedly close the annular preventer against the full open hole, as in Fig 14, you greatly shorten the life of the cartridge-type packing unit. For that reason, use it as a master gate (packing off open hole) only in emergencies. Too, remember that square or hexagonal kellies, Fig. 15, should not be rotated within the closed packing unit.

Here is something to remember when stripping, rotating or reciprocating the drill string with the preventer closed. It is important to adjust the regulator valve on the blowout preventer control manifold. The pressure on the packing unit should be reduced until there is very slight leakage between the rubber packing unit and the drill string. Doing this cuts the wear on the rubber-cartridge-type packing so it can be used much longer.

During stripping operations, when a tool joint enters the closed packing unit, it displaces rubber outwardly as in Fig. 16. This puts a downward thrust against the contractor piston and raises the closing chamber pressure. The increase in pressure causes the regulator valve to release fluid automatically from the closing cham-

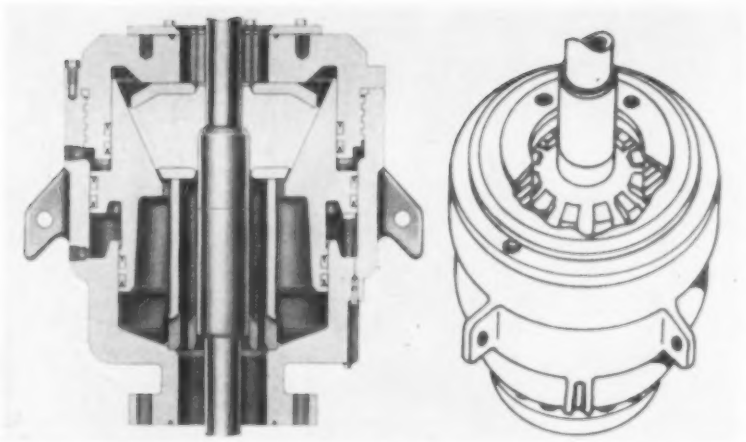


Fig. 16—As this figure shows, tool joints can be stripped through the annular preventer. It should not be done at a high rate of speed and regulating valve should be connected to source on continuous pressure.

ber; and the contractor piston moves downward so the tool joint can displace more rubber outward.

When the tool joint passes out of the packing unit some of the downward thrust against the contractor piston is relieved. So, the closing chamber pressure decreases momentarily. With this decrease in pressure, the regulator valve admits more fluid automatically from the pressure supply into the closing chamber. The extra pressure lifts the piston to its original position, and the packing unit is squeezed into closer contact with the pipe.

The time required for the stripping operating cycle is between 1 and 2 seconds. Therefore, tool joints should not be stripped at a high rate of speed. To properly strip through a closed

Fig. 17

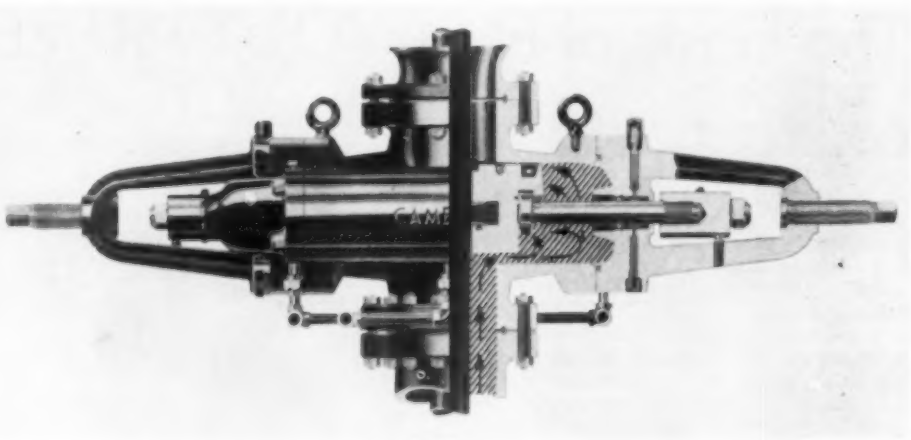


Fig. 18

If the rubber-type cartridge unit wears out, it can be replaced in this way, (left), and a new one put in. Even though cut through, the unit will still seal. At right is a common brand of the ram-type preventer. Well pressure is bypassed to the back of the rams.

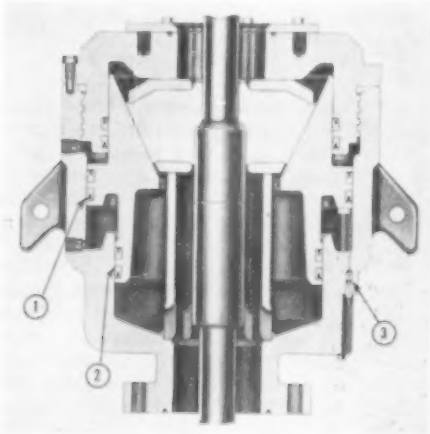


Fig. 19

OPERATION AND MAINTENANCE OF HYDRIL PREVENTER

1. Close the preventer at least once daily when in high pressure formations and on every trip.

2. When pressure testing preventer and it fails to hold desired pressure check for the following:

(a) Remove drill pipe or test tool from preventer and try closing preventer over open hole. If the preventer fails to close, open it back up and wash between the steel fingers in the packing unit, removing any accumulated mud or debris.

(b) If preventer still fails to hold desired pressure after performing step (a), break out the opening chamber line and determine if fluid continues to come through the line after the initial amount contained in the opening chamber is displaced by the closing or upward movement of the contractor piston. If fluid continues coming through the line the seal at point (1) is leaking. If so, dismantle the preventer, clean, inspect, and replace any defective seals or parts.

(c) If the seal at point (2) leaks the preventer will still function unless the leak is severe or bad, in which case it will be very evident as fluid can be seen entering into the bore of the preventer.

(d) If the indicator seal, point (3), leaks it will prevent the preventer from holding the desired pressure, and will require replacement of the piston indicator seal.

3. To obtain best performance from the Hydril preventer calls for periodic disassembling, cleaning, inspection, replacement of worn parts and reassembling. In reassembling, coat all metal parts and sealing rings with lubricating oil. Make certain all seal rings are assembled with sealing edges in the position indicated in the manual.

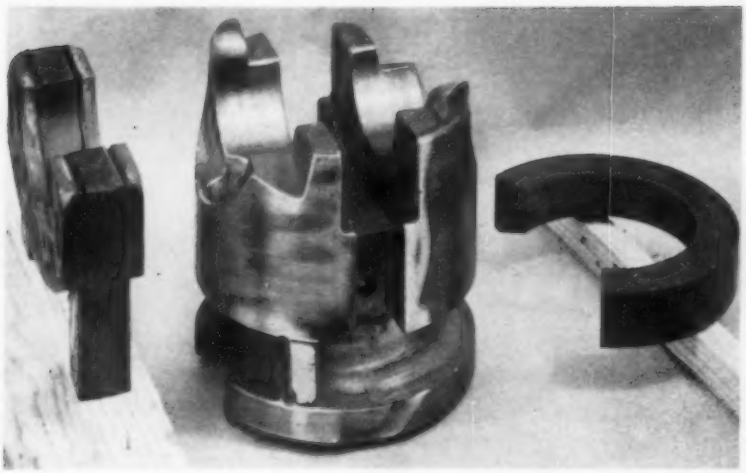


Fig. 20—These self-feeding ram elements permit pipe movement with the rams closed. The rubber "flows" against the pipe to seal.

Fig. 21—Changing rams in a ram-type preventer. The lower rams should be for the size pipe in use. Upper ones should be blind rams.

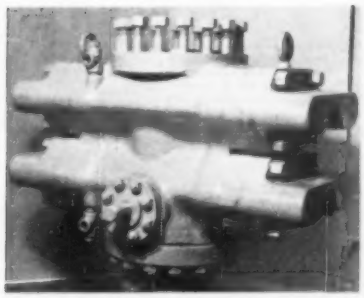


Fig. 22—This "space saver" model preventer is intended for use primarily on rigs where there is too little room under the floor for the basic blowout-preventer assembly with two sing'e models.

preventer, the regulator valve must be connected to a supply of continuous pressure.

After rotating and reciprocating a long time to control a kick, the annular preventer's rubber-type cartridge unit may wear out. If so, the ram-type preventer can be closed and the worn-out rubber type cartridge unit replaced in this way:

1. Unscrew the blowout preventer head. Then, lift the worn-out rubber cartridge unit up the drill string out of the preventer.

2. Using a knife or saw, cut through the rubber cartridge unit between two of the steel metal ribs. Remove it from around the drill string as in Fig. 17.

3. Using a knife or saw in the same manner cut the new rubber cartridge unit. Place it around the drill string and lower it into position. Then, screw back on the blowout-preventer head.

4. Close the annular preventer, open the ram preventer, and continue to reciprocate and rotate your drill string.

Fig. 19 gives instructions on operation and maintenance of one type of annular blowout preventer.

B. Ram-type preventer. Blowout-preventer rams come in specific types. There are blind rams which completely close off the well. And there are rams of several different sizes, each of which is made to close off around one particular size of tubing, drill pipe, or casing.

In general, the ram-type preventer can be closed quickly; it holds well against extremely high well pressures; and the rams can be changed quickly and easily.

One common brand of the ram-type preventer has a built-in safeguard against the high pressures found in deeper drilling. This type of preventer has a closing to well pressure ratio of approximately 8 to 1. Thus, 1,000 psi. closing pressure will close the rams against approximately 8,000 psi. well pressure. As Fig. 18 shows, well pressure is bypassed to the back of the rams. Thus, well pressure actually helps close the rams. Operating cylinders on all sizes of this model are tested to 5,000 psi. Figs. 20 and 21 show the rams.

Of course, the ram-type preventer must be installed so well pressure will be on the back of the rams. If this is not done, the closing to well pressure ratio of 8 to 1 is lost. Although the preventer will still hold pressure,

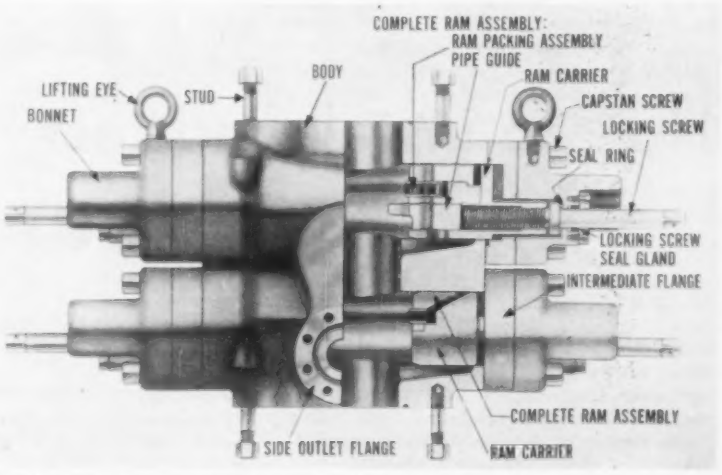


Fig. 23—Operation and maintenance of the double "space saver" preventer is essentially the same as for the standard type.

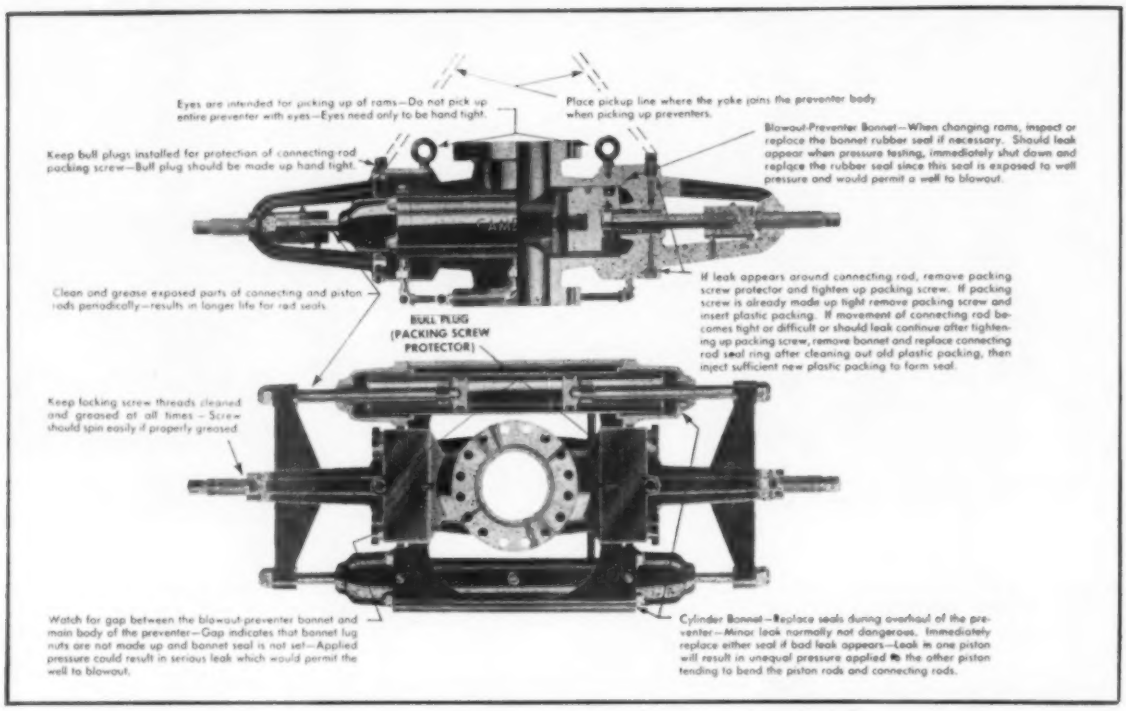

Eyes are intended for picking up of rams—Do not pick up entire preventer with eyes—Eyes need only to be hand tight.
Place pickup line where the yoke joins the preventer body when picking up preventers.
Blowout-Preventer Bonnet—When changing rams, inspect or replace the bonnet rubber seal if necessary. Should leak appear when pressure testing, immediately shut down and replace the rubber seal since this seal is exposed to well pressure and would permit a well to blowout.
Keep bull plugs installed for protection of connecting rod packing screw—Bull plug should be made up hand tight.
If leak appears around connecting rod, remove packing screw protector and tighten up packing screw. If packing screw is already made up tight remove packing screw and insert plastic packing. If movement of connecting rod becomes tight or difficult or should leak continue after tightening up packing screw, remove bonnet and replace connecting rod seal ring after cleaning out old plastic packing, then inject sufficient new plastic packing to form seal.
Clean and grease exposed parts of connecting and piston rods periodically—results in longer life for rod seals.
BULL PLUG (PACKING SCREW PROTECTOR)
Keep locking screw threads cleaned and greased at all times – Screw should spin easily if properly greased.
Watch for gap between the blowout-preventer bonnet and main body of the preventer—Gap indicates that bonnet lug nuts are not made up and bonnet seal is not set—Applied pressure could result in serious leak which would permit the well to blowout.
Cylinder Bonnet—Replace seals during overhaul of the preventer—Minor leak normally not dangerous. Immediately replace either seal if bad leak appears—Leak in one piston will result in unequal pressure applied to the other piston tending to bend the piston rods and connecting rods.

Fig. 24

MAINTENANCE OF CAMERON PREVENTERS—Operate all preventers at least once daily when in high-pressure formations and on every trip. Disassemble and inspect preventer if over 150-psi. pressure is required to operate a preventer against zero well pressure. When moving or storing: (1) Wash or steam thoroughly; (2) Thoroughly grease and oil; (3) Withdraw and remove rams; (4) Wash and inspect ram bore and then grease with ram lubricant; (5) Thoroughly flush cylinders and pistons with water; (6) Grease cylinder and pistons by pouring in lubricating oil through the three 1-in. pipe-plug connections in the top of the cylinder heads on each side of the preventer; (7) Protect greased flange faces with wooden or sheet-metal covers.

it will require a much higher closing pressure to make it hold. Opening pressure ratio on this model preventer varies from 0.62 to 1.83. If the preventer is installed incorrectly or upside down this would then become the closing ratio. As you can see, effectiveness of the preventer would be greatly reduced.

Figs. 22 and 23 show the "space saver" model used under low substructures.

Fig. 24 gives instructions for maintenance of a common ram preventer. Here are some features of this model:

1. It has self-feeding ram-packing element which permits pipe movement with the rams closed. The oil-resistant rubber packing is designed so, when the rams are closed, packing is forced to flow to the pipe and seal. This packing element is shown on the figure.

2. Rams automatically center pipe in the hole.

3. "Oversized" bore permits passing casing and tubing hangers.

4. Cuttings cannot accumulate in the round ram bore and prevent closure of the rams.

How to install and test BLOWOUT PREVENTERS

MUD is the primary blowout preventer. But, sometimes too-low mud weight, poor drilling practices (hole filling and swabbing) and lost circulation make it necessary to fall back on the surface blowout preventers. Then the difference between safety and disaster is the speed with which you obtain a positive shutoff using your blowout preventers.

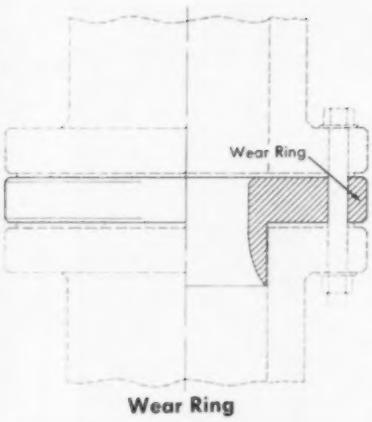
A. Installation.

Some of the things which should be included in any blowout preventer requirements are:

1. A blowout preventer hookup is no stronger or better than its weakest link. For this reason, a 10,000-psi.-working-pressure preventer is of no use if it is installed incorrectly or has low-pressure valves and connections attached to it. Be sure to specify that all valves, manifold piping, fittings, and connections be able to withstand the pressure to which they may be subjected.

2. All connections to the blowout preventers through which well-bore fluid will be flowing should have two valves on them. If the outside valve leaks, the inside valve can be closed

Fig. 25—Hand wheels for operating the preventers should be properly installed, braced if necessary, and tested to see they actually work.



Wear Ring

Fig. 26—Where the preventers are larger in nominal pipe size than the last string of casing set, use a wear ring below preventers and above casing head.

and the outside valve then replaced.

3. All valves and connections on the preventer assembly should be readily accessible so they can be repaired or replaced if necessary.

4. Threaded casing-head connections should not be used for choke or fill-up outlets except in an emergency.

5. If possible, have the choke manifold away from the blowout preventers. Then you will have better working conditions for changing chokes, etc.

6. Put a pressure gage where it will show the annulus pressure. Install it on the choke manifold setup, on the casing head, or on the drilling spool. If it is on the casing head or drilling spool, use two valves under the gage.

7. Choke lines should be big enough, well anchored, and as streamlined as possible.

8. The blowout-preventer assembly should be properly braced and turnbuckled to prevent vibration or movement. The turnbuckling should be carefully done; avoid any strain that might cause the riser to break in the first collar.

9. A good basic choke manifold arrangement has at least two chokes, one positive and the other adjustable. For the positiv choke, keep handy a supply of different size choke beans (1 in., ¾ in., ½ in., and ¼ in.). Of course, a choke wrench must also be readily available. At first, use a large-size choke bean. This will prevent putting a high pressure on the annulus, thereby breaking down any exposed formation and causing loss of circulation.

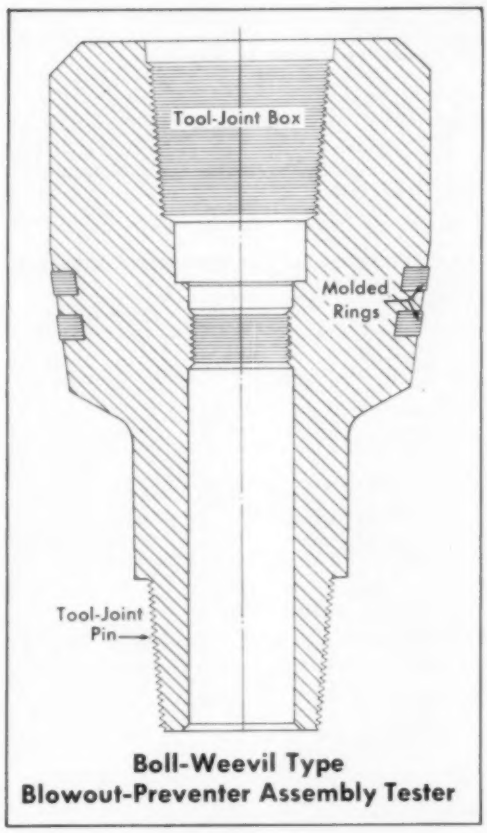
10. The manifold for closing and opening the preventers should be on or adjacent to the derrick floor. A good location is one which is near the driller's position and readily accessible. On offshore rigs or platforms, and when drilling in high-pressure formations, it is advisable to have a second or auxiliary manifold from which point the preventers can be closed. The second manifold should be at least 75 ft. from the well.

11. The blowout-preventer manifold should be simple to operate and the directions for operating it should be plainly shown. **It is the driller's duty to be sure each member of his crew fully understands how to operate the control manifold and manifold piping.**

12. Use the proper fluid, preferably a good-grade oil, in the hydraulic control system for opening and closing the preventers. In cold climates, see that no water gets into the hydraulic system; it could collect in a low place, freeze, and prevent closing the preventers.

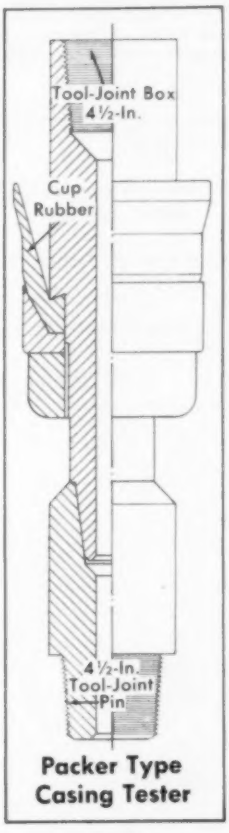
13. Hand control wheels for manually closing the preventers should be properly installed and braced if necessary. You should actually test them to see that they will work.

14. Check every bolt and connection on a blowout-preventer assembly.



Boll-Weevil Type Blowout-Preventer Assembly Tester

Fig. 27



Packer Type Casing Tester

Fig. 28

Use boll-weevil type tester to test preventers before drilling out cement in bottom joint of casing. If there's protective pipe in the hole or if there's a wear ring in the blowout preventer assembly, you will have to use a packer-type casing tester.

Fig. 29—The kelly cock is part of the blowout-prevention equipment. It should be properly pressure tested to make sure it will operate satisfactorily when needed.

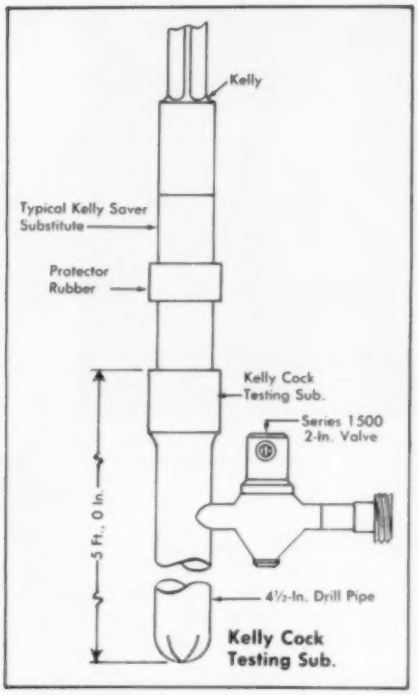


Fig. 30—This is a sub for pressure-testing the kelly cock. Tests should be made regularly.

See that they are tight and properly assembled before you pressure-test the whole assembly. Because of the vibration of the blowout-preventer assembly when drilling, make periodic checks to see that all of the bolts remain tight.

15. Before drilling ahead, check the alignment of the drill string in the upper part of the casing below the preventers. Make sure that the kelly does not wear against the casing. Where the preventers are larger in nominal pipe size than the last string of casing set, use a wear ring below the preventers and above the casing head. An example would be where 10¾-in. casing had been set and 13⅜-in preventers are to be used. The wear ring is a heavy flange-type device having the same inside diameter as the casing being used, as shown in Fig. 26.

16. Power rigs (diesel-electric, or gas) should have an automatic blowout preventer operating pump or accumulator capable of closing any of the preventer equipment in less than 1 minute. Most rigs drilling abnormal-pressure formations have both the blowout-preventer operating pump and the accumulator.

Steam rigs don't usually need an accumulator if they have either boiler feed or special pumps capable of quickly and properly actuating tne preventers.

B. Blowout preventer, kelly cock, and casing tests.

When drilling where there may be abnormally high pressures, it is advisable to make these blowout-preventer, kelly-cock, and casing tests:

1. Routine tests before drilling out.

TABLE 4—MINIMUM INTERNAL YIELD PRESSURE FOR DIFFERENT SIZES AND GRADES OF CASING

Size, o.d. (in.):	Wt. nom. (lb./ft.)	Csg. i.d. (in.)	Drift dia. (in.)	J-55 (psi.)	Grade N-80 (psi.)	P-110 (psi.)
5	15	4.408	4.283	5,700	8,290	11,390
	18	4.276	4.151	....	10,140	13,940
5½	15.5	4.950	4.825	4,810	....	....
	17.0	4.892	4.767	5,320	7,740	10,640
	20.0	4.778	4.653	....	9,190	12,640
7	23.0	6.366	6.241	4,360	6,340	....
	26.0	6.276	6.151	4,980	7,240	9,960
	29.0	6.184	6.059	....	8,160	11,220
	32.0	6.094	5.969	....	9,060	12,460
	35.0	6.004	5.879	....	9,960	13,690
	38.0	5.920	5.795	....	10,800	14,850
7⅝	26.4	6.969	6.844	4,140	6,020	....
	29.7	6.875	6.750	....	6,890	9,470
	33.7	6.765	6.640	....	7,890	10,860
	39.0	6.625	6.500	....	9,180	12,630
9⅝	40.0	8.835	8.679	3,950	5,750	....
	43.5	8.755	8.599	....	6,330	8,700
	47	8.681	8.525	....	6,870	9,440
	53.5	8.535	8.379	....	7,930	10,900
10¾	40.5	10.050	9.894	3,130	....	....
	45.5	9.950	9.794	3,580	....	....
	51.0	9.850	9.694	4,030	5,860	....
13⅜	54.5	12.615	12.459	2,730	....	....
	61.0	12.515	12.359	3,090	....	....
	68.0	12.415	12.259	3,450	....	....
	72.0	12.347	12.191	....	5,380	....

Blowout-Preventer Check List

Date _____ Total Depth _____ feet.

Drilling Contractor _____ Company Rig No. _____

Field _____ Lease _____ Well No. _____

A. Blowout-Preventer-Assembly Pressure Test:

	Pressure Applied	Time Held	Did Pressure Bleed Down
Annular Preventer	_____	_____	_____
Ram-Type (Blind Rams)	_____	_____	_____
Ram-Type (Pipe Rams)	_____	_____	_____

Was the last valve on the choke manifold used as a stop _____

Was the outer valve where two valves are employed used as a stop _____

Top Joint of Casing: Size_____ Weight _____ Grade _____

B. Casing Pressure Test:

Pressure applied _____ Time Held _____ Did Pressure Hold _____

If pressure bled off, how much did it bleed off _____ How many feet of casing were tested _____

If casing bled off more than 100 psi. and the leak was not repaired was the division manager notified _____

C. Kelly-Cock Pressure Test:

Pressure applied _____ Time Held _____

Did Pressure Hold _____ Did valve close easily _____

D. Were the following pieces of equipment on the rig:

1. Circulating head _____
2. Inside blowout preventer on derrick floor _____
3. Pit level recorder properly installed and working correctly _____
4. Operating control manifold properly installed and the different blowout preventers correctly labeled _____
5. Automatic accumulator properly installed _____
6. Pressure gage properly installed on choke manifold or BOP assembly _____
7. Locking wheels on ram-type blowout preventers correctly installed _____
8. Approximate number of sacks of weight material on hand _____
9. Size of positive choke beans on hand _____
10. Size of choke beans installed in choke manifold _____
11. Double "O" safety seal rings installed in flanged connections _____

Leaks: If any leaks occurred show where they occurred and how they were repaired:

Where Leak Occurred	How Repaired
_____	_____
_____	_____
_____	_____
_____	_____

Driller _____ Drilling Foreman _____

Company Representative _____ Title _____

(a). After properly installing the blowout-preventer assembly, make a boll-weevil packer test before drilling the cement out of the bottom joints of casing. Seat the boll-weevil packer, Fig. 27, in the casing housing and flush the mud above the tester out thoroughly with clear water. Close the preventers, and flow-line valve if used, and the outermost valves on the choke manifold. Put their full working pressure on the preventers; i.e., on Series 1500 put 5,000 lb., on Series 900 put 3,000 lb.

Separately test each preventer and each valve in the choke manifold and on the blowout-preventer assembly. See that they shut off against the test pressure.

If a protective casing has been set or if there is a wear flange in the blowout-preventer assembly, you will have to use a packer-type casing tester, Fig. 28, instead of the boll-weevil packer to test the blowout-preventer assembly. If the top joint of casing has a minimum internal yield pressure greater than the test pressure to be used, you may set the packer-type tester any place in the top joint of casing. Otherwise, use a test pressure equal the minimum internal yield pressure or burst pressure of the top joint of casing. Table 4 gives minimum internal yield pressures on popular casing sizes and grades. Repeat this same test at regular intervals, say every 5 to 7 days.

(b). Test the top 100 ft. of casing before drilling the cement. Here is how to perform this test. Run a packer-type casing tester about 100 ft. into the casing. Fill the top 100 ft. of the casing annulus with clear water by reversing out. Then close the preventer with blind rams and the flow-line valve (if used). Apply 1,500 to 2,000 psi. and hold it for 30 minutes. If there is a pressure drop of as much as 100 psi., you should very seriously consider repairing the leak before drilling ahead.

This is also a good test to make periodically afterwards. It will tell you if the casing has been worn because of derrick misalignment and will not withstand a normal amount of pressure.

(c). The kelly cock is part of the blowout-prevention equipment and should be properly pressure tested. The cock is a valve in the drilling string between kelly and swivel joint and is a positive means of shutting off flow in the drill string. It prevents the swivel, rotary hose, and standpipe from being subjected to abnormally high pressures. Some kelly cocks are constructed so they hold pressure in only one direction. With these, it is necessary to devise some method to put pressure on the inside of the drill string below the kelly cock. Kelly-cock pressure tests should be made with the same regularity as blowout-preventer pressure tests. Fig. 30 shows one method of pressure testing a kelly cock.

2. Other miscellaneous tests.

(a). If the protective string has been subjected to much wear, it is advisable to run a caliper survey on it before drilling in an abnormally pressured zone. After that, it's good safety practice to caliper the casing about every 30 days; if wear is severe, the calipers might be run even more often. Then from thickness of the casing as measured by the caliper, you can figure the pressure that can be safely allowed on the casing without its bursting. You can also determine if the casing is worn so badly that another protective string should be run.

(b). The caliper survey may show that the protective pipe has been worn badly. Or, you may know this from the length of time that the pipe has been drilled in. Then, it's a good safety measure to pressure test the casing to the pressure you think it might have to hold if you drill, or continue to drill, in the abnormal-pressure formation.

Some equipment to help in DETECTION AND CONTROL

A. Pit-level indicators.

1. When drilling high-pressure formations, it's essential to have some means of measuring and recording mud level in the pits. Reasons for need of a pit-level indicator are:

(a). It will show when a well is starting to kick. There will be an abnormal rise in pit level which shows that oil, gas, or salt water is entering the mud system. You will then know you have to take countermeasures to get the well under control. If you bring the well under control immediately, you prevent possibility of a blowout, avoid excess contamination of the mud, and keep the pipe from sticking. Also you will not have to hold a high pressure on the formation and run the risk of lost circulation.

(b). When making a trip, a driller can see that his hole is properly taking or displacing mud.

(c). It will show when there is lost circulation. As a result, you can avoid pumping away large quantities of mud before taking corrective action.

(d). It assists in bringing a well under control after it has started to kick.

2. Since a pit-level indicator is so important, take these precautions to get the most good out of it:

(a). Place the pit-level recording instrument at or near the driller's position on the derrick floor. The driller should be able to see it easily while making a trip or drilling. A good position for it is atop the weight indicator as shown in Fig. 31.

(b). The float should be in a quiet place in the suction pit. Then, it can reflect the true level of the pit and not be affected by a mud mixer or mud gun. The float and float arm or guide wires should be kept clean and free of dried mud.

(c). The suction pit should be small enough that a small change in the volume of the mud system will be reflected by a noticeable change in volume of the suction pit.

(d). Hook up degassers and other mud equipment so their operation will not cause changes in the mud system.

(e). Maintain mud volume of the suction pit within the recording limits of the pit-level instrument by jetting or by adding reserve mud. If you do, the recording indicator of the instrument will indicate the true level and changes of the mud in the suction pit.

Fig. 31—A good position of the pit-level recording instrument is atop the weight indicator. The driller should be able to see it easily.

Fig. 32—Float of the pit-level indicator should be in a quiet place in the suction pit. Then, it can reflect true level.

Fig. 33—It should be standard practice for the derrick man to tell the driller whenever he does anything to change mud volume.

(f). Make this standard procedure: when the derrick man jets a pit or does something else to change mud volume, he should tell the driller what he has done or is going to do. The driller should note the change on the pit-level chart.

(g). The derrick man should occasionally check the mud level in the suction pit. He should compare changes in volume with the changes shown by the pit-level indicator to make sure it is operating properly.

(h). Drillers should take pains to put the recorder charts on correctly. They should also see that the time on the sheets is set to the correct time. Also, the driller should write on the chart anything unusual.

3. Figs. 34, 35, 36, and 37 are pit-level charts. They show such well conditions as lost circulation, well kicking, routine drilling, etc.

4. Pit-level indicating devices are

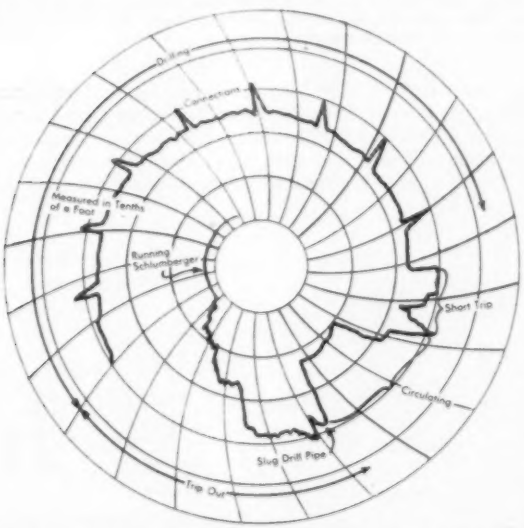


Fig. 34—This chart illustrates a normal day's drilling operations when drilling an exploratory well in abnormal pressured formations. Starting at midnight the chart shows the following:

Time	Event
12:00 to 1:45 p.m.	Drilling, the gradual loss in mud volume due to use of a mud centrifuge and the additional hole drilled.
1:45 to 2:15 p.m.	Circulating.
2:15 to 3:45 p.m.	Short trip to check on swabbing.
3:45 to 6:30 p.m.	Circulating mud off bottom to insure that the mud weight was sufficient to handle any swabbing action.
6:30 p.m. to midnight	Trip out of hole to Schlumberger.

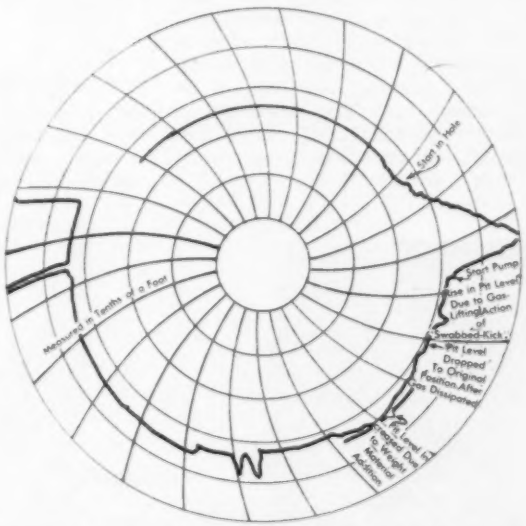


Fig. 35—This record shows the sequence of events which occurred after a trip on which a swabbed show was obtained. At 3:00 p.m. the drill pipe was started back in the hole causing the mud level to rise as the drill pipe displaced mud from the hole to the pit. Back on bottom at 5:24 p.m., the mud level was arbitrarily changed by pumping mud to a reserve pit, and the pumps started and the mud circulated conventionally. Forty-five minutes later there was a rise in the pit level indicating a swabbed gas show, the increase in pit level being less than 15 minutes in duration and returning to its original level. Although the mud weight was raised as is indicated by the gradual increase in the pit level, it is doubtful if it would have been necessary to raise the mud weight as this swabbed show was of such short duration.

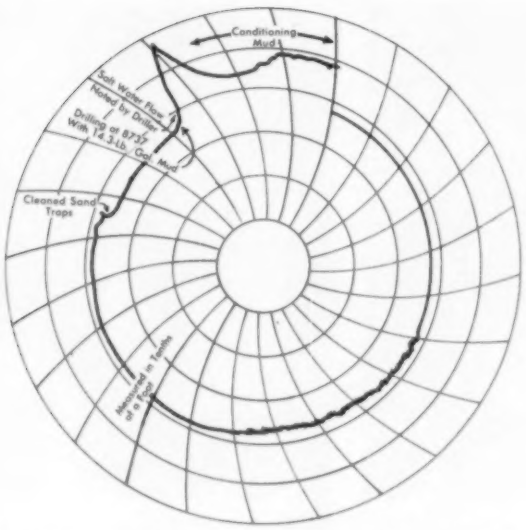

Conditioning Mud
Salt Water Flow Noted by Driller
Drilling at 8735 With 14.3 Lb. Gas Mud
Cleaned Sand Traps
Measured in Tenths of a Foot

Fig. 36—This chart shows the occurrence of a salt-water flow that occurred on State Lease Well No. 1 at 8,737 ft. The driller noted the increase in mud level after a gain of only 0.3 ft. and had the blowout preventers closed and the well put on a choke. The early detection of this salt water flow prevented the mud from becoming very contaminated and conditioning the mud was then comparatively simple. At the time of the flow the mud weight was 14.3 lb. per gallon. Six hours after the flow was detected drilling was resumed using 15.5 lb. per gallon mud. It is felt that due to the early detection of the flow a considerable savings in both rig time and mud-weighting materials resulted.

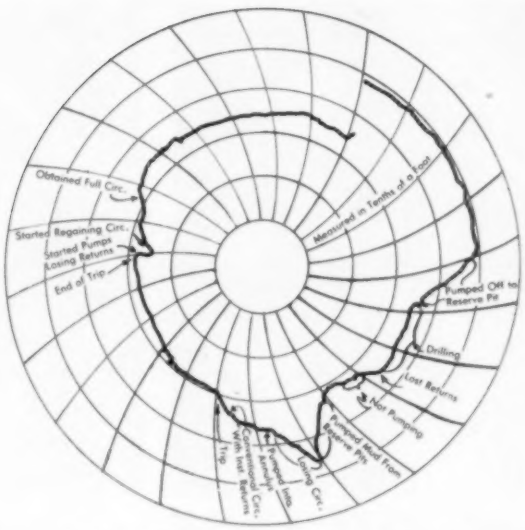


Fig. 37—While drilling at 10,906 ft. with 12.8 lb. per gallon mud, lost circulation was detected by the mud-level indicator. From 8:00 a.m. until noon the drilling was normal with no mud level changes. At noon, the mud level was arbitrarily changed by pumping mud from the active mud pit to the reserve pit. This took about 45 minutes with normal drilling continuing. At 2:45 p.m., the mud level started dropping, indicating lost circulation. The pumps were stopped and additional mud was pumped into the active mud system from the reserve pit. Still, only partial returns were being received with conventional circulation, so at 5:55 p.m., the bit was pulled off bottom and mud was pumped into the annulus. This reduced the rate of lost circulation, but not enough to be significant, so conventional circulation was restored. At 7:00 p.m. a trip was made to change bits. When back on bottom at midnight, the pumps were started with no returns being obtained for 10 minutes, at which time partial returns were obtained. By 1:30 a.m. full returns were being obtained.

nearly all similar in design. They have a float in the mud tank which actuates a transmitter unit. This equipment is connected by an air or fluid system to a recording, receiving unit on the derrick floor. The recording part of the instrument requires outside compressed air or gas, pressure of which is not critical.

The float-actuated transmitter in the suction pit comes in two types. One is a float on a long arm. The other is a float on a small monel rod, vertical movement of which is guided by two monel wires. Mud will sometimes dry on the wires of the second type and prevent upward movement of the float. With either type, the float should be located in a quiet part

Fig. 38

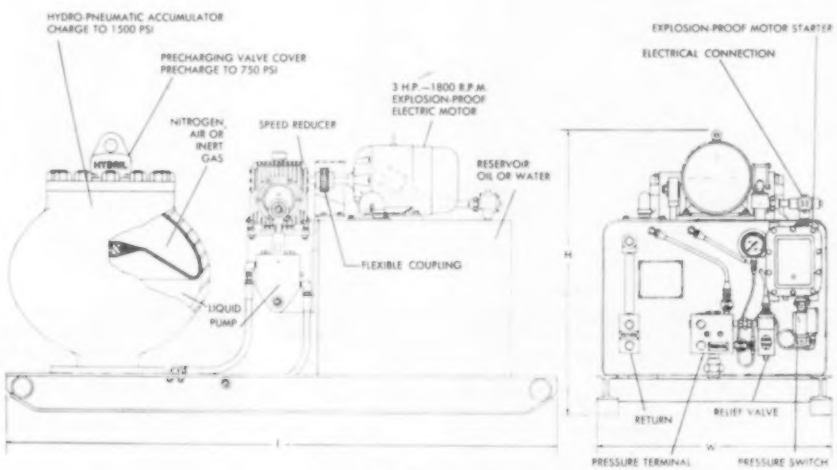


Fig. 39

Automatic accumulators like that at left are an everready stored supply of high-pressure fluid for instantly closing blowout preventers. At right is a commonly used accumulator which comes with either 40-gal. or 80-gal. hydropneumatic accumulator.

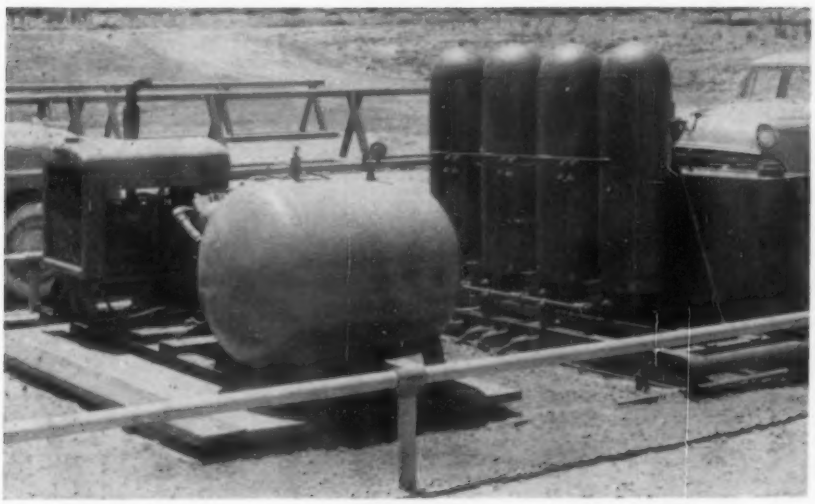
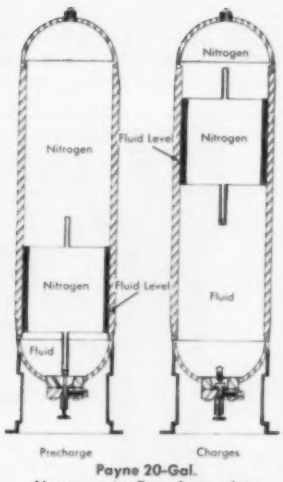


Fig. 40



Payne 20-Gal.
Nonseparator-Type Accumulator

Fig. 41

Accumulators eliminate the hazardous delay you sometimes have starting motors and pumps when a blowout threatens (left). At right is the nonseparator type accumulator unit shown. At left the float separates fluid and gas charge.

of the suction pit so it will give accurate readings.

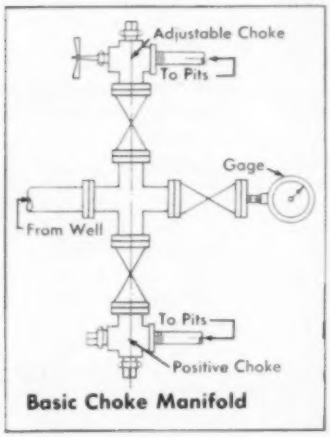
B. Automatic accumulators.

Automatic accumulators are an everready stored supply of high-pressure fluid for instantly closing blowout preventers. They eliminate the hazardous delay you sometimes have starting motors and pumps when a blowout threatens.

Figs. 38 and 39 show a commonly used accumulator which comes with either 40 or 80-gal. hydropneumatic accumulator. Both sizes have 1,500-psi. rated working pressures and 3,000-psi. test pressure.

Air or nitrogen at 750 psi. precharges the accumulator chamber above the impervious diaphragm. This diaphragm separates the gas that's above it and the liquid below. The precharged pressure is sealed in. And, under normal conditions, it will last for many months.

The liquid stored in the reservoir is pumped into the accumulator cham-



Basic Choke Manifold

Fig. 42

You must have at least two chokes if you are to change a choke bean without shutting the well in. Above is a good basic arrangement with one positive and one adjustable choke. At right—There are two general types of chokes—positive and adjustable. It is best to have both in a choke manifold.

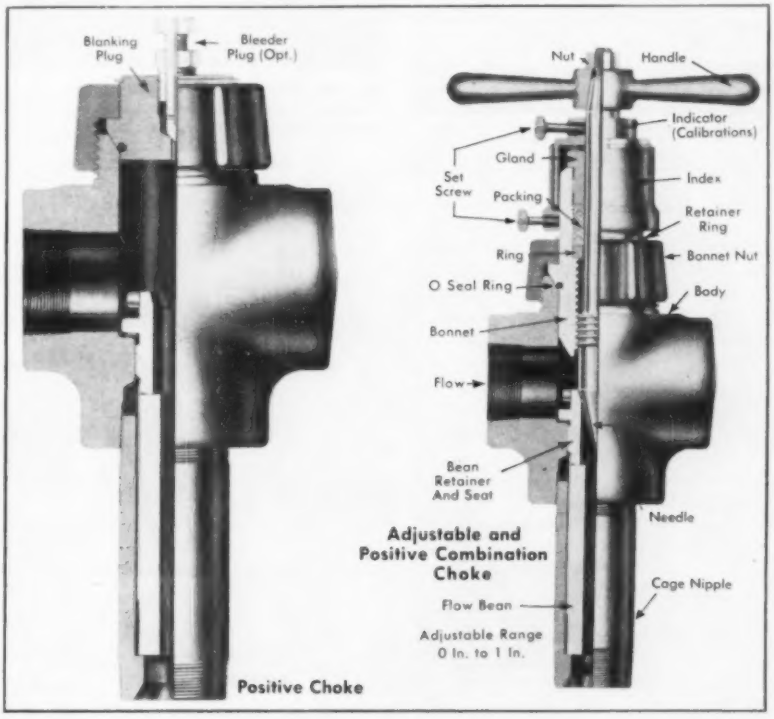


Fig. 43

ber until pressure reaches 1,500 psi. At this point, a pressure switch automatically stops the motor and pump.

A light lubricating oil (S.A.E. 10) is best to use in an automatic accumulator. Although water may be used, it may freeze in cold weather. Diesel oil is bad because it may wash out the lubricating grease in the four-way valves in the blowout-preventer manifold.

At 1,500 psi., the 40-gal. unit has 20 gal. of hydraulic-pressure fluid stored in the accumulator; the 80-gal. unit has 40 gal. As soon as a small portion of this fluid is withdrawn, the pressure switch automatically restarts the motor and pump and restores the volume consumed.

The accumulators need very little maintenance. Reasonable attention to lubrication, reservoir-fluid level, and precharge pressure will insure good service.

Figs. 40 and 41 show a second type of accumulator. It has a pump, non-separator type accumulator, fluid reservoir, and fluid-control manifold. This brand comes in sizes up to 120 gal. with 2,000-psi. working pressure. When pressure drops to 1,800 psi.

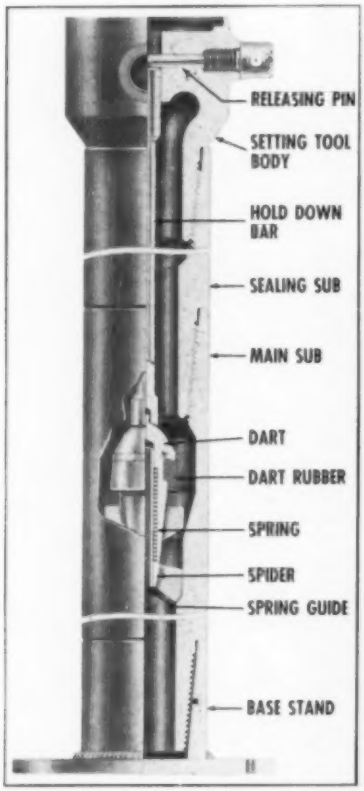


Fig. 44—Every rig should have an inside blowout preventer on the derrick floor ready in case of a blowout through the inside of the drill pipe.

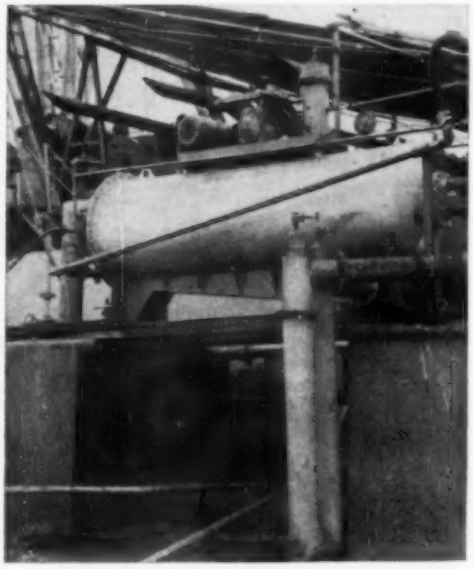


Fig. 45—When drilling abnormal-pressure formations, it's essential to know true weight of the mud. A degasser like this will make the problem easier.

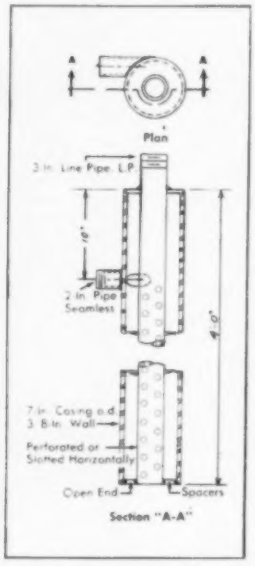


Fig. 47—Homemade degassers not so effective as the vacuum type.

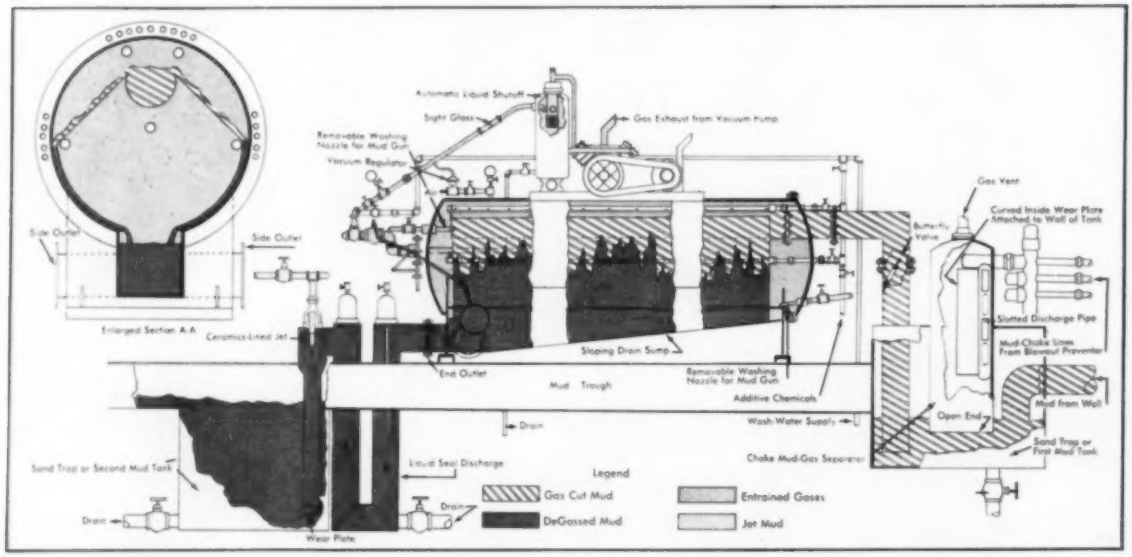


Fig. 46—This type degasser is similar to an oil-gas separator. It also has a small vacuum pump to pull off entrained gas.

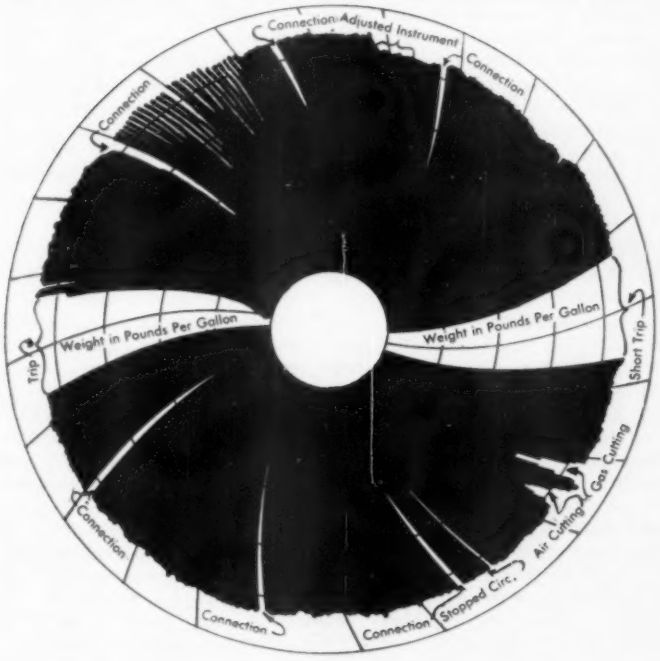


Fig. 48—This is a chart showing the continuous recording of the mud weight of a mud used in drilling an abnormally pressured zone. The chart was put on at 7:40 a.m. and the events which took place are as follows:

9:50 to 10:00 a.m.	Connection
12:55 to 12:35 p.m.	Connection
1:50 to 2:15 p.m.	Adjusting Mud-O-Graph
2:40 to 2:50 p.m.	Connection
6:15 to 7:40 p.m.	Short trip
9:05 to 9:20 p.m.	Swabbed gas due to short trip.
9:35 to 9:45 p.m.	Air trapped in drill pipe when starting to circulate after short trip.
10:55 to 11:00 p.m.	Stopped circulation
11:20 to 11:25 p.m.	Connection
2:05 to 2:10 p.m.	Connection
4:50 to 5:00 a.m.	Connection
6:20 to 7:40 a.m.	Trip out of hole.

in the accumulator, the pump automatically returns it to 2,000 psi.

C. Choke manifold.

The choke manifold is an arrangement of valves and chokes through which we can put the mud stream from the well. The manifold should be arranged so the size of the choke bean in any one of the chokes can be changed without shutting the well in. To do this, you must have at least two chokes in the hookup. If drilling unusually high-pressure formations, you should have more. Three or more chokes make a much more flexible and useful hookup.

A good basic arrangement is to have one positive choke and an adjustable choke, as shown in Fig. 42.

D. Chokes.

There are two general types of chokes—positive and adjustable. Fig. 43 shows them. It is best to have both in a choke manifold. A positive choke will not cut out as fast an an adjustable choke but it is not as flexible. With an adjustable choke, you can vary the size of the choke bean without having to shut down and change the bean. This is an important feature when you are killing a well; the adjustable choke lets you reduce back pressure by increasing the size of the choke. Still, you can maintain the pit level constant without varying the speed of the pump.

If you use only positive chokes in the manifold when killing a well, you will have to make frequent changes in the size of the choke. Also, you will have to vary pump speed to maintain the mud level in the pits constant.

E. Inside blowout preventers.

Every drilling rig should have an inside blowout preventer or some other similar device. It should be on the derrick floor ready in case of a blowout through the inside of the drill pipe. An inside preventer is nothing more than a back-pressure valve. It can be screwed into the drill pipe open; then, the valve can be released to shut off back flow. It will still allow normal pumping into the drill pipe. Fig. 44 shows an inside preventer.

Even when back flow through the drill pipe is so strong you can't screw on the kelly, an inside preventer lets you shut it off. After the inside preventer is in place, you can screw on the kelly or some other equipment. An inside blowout preventer will also protect the hose, standpipe, slush pumps, swivel packing, and especially pot-cover gaskets from pressures they cannot stand.

There is one disadvantage to an inside blowout preventer. When it's in place, there's no way to measure the pressure below it on the inside of the drill pipe.

F. Degassers.

When drilling abnormal-pressure formations, it is essential to know the true weight of the mud you are pumping into the hole. Sometimes, this is difficult to do because the mud in the pits may be gas cut. And, by the time the gas has been removed, you may have raised the mud weight 0.5 lb. per gallon higher than you intended. Of course, this is a waste of lots of expensive weight material. Furthermore, it can very often cause loss of circulation.

Now, there is degassing equipment which will eliminate this problem. One type of degasser, shown in Figs. 45 and 46, is an enclosed vessel, similar to an oil-gas separator. In it, the mud passes over a baffle. There is a small vacuum pump attached which maintains a vacuum inside.

Because of the vacuum, all or nearly all the air or gas trapped in the mud is extracted as the mud passes over the baffle. At each end, there is a boot arrangement through which the incoming and outgoing mud passes. These make it possible to hold the vacuum on the vessel without taking out any mud.

In actual field tests, this degasser has taken in 16.0 to 17.0-lb. per gallon mud which has been cut back to less than 8.0 lb. per gallon. It put the mud out weighing within 0.1 lb. per gallon of what it first weighed.

The degasser has a jet which pulls the mud through. This jet also helps condition the mud by agitating it so that the gels and viscosity are reduced. Mud going into the jet is puked up from the mud pits and is then mixed with the flow-line mud. For this reason, the degasser also "smooths out" the mud.

Homemade degassers, like that in Fig. 47, give some aid, but are not as effective as the vacuum type.

G. Mud-weight recorders.

A mud-weight recorder is good to have on a rig, but it is not nearly so

essential as a mud-pit-level recorder when you are drilling abnormal-pressure zones. The reason is that, by the time gas or salt-water-cut mud gets to the surface, the kick or blowout is well on its way.

A mud-weight recorder does have these advantages:

1. It gives a record of mud weight.
2. It tells the duration and intensity of swabbed or drilled shows.
3. It shows how well balanced or even the density of the mud system is. One brand of mud-weight recorder measures density by measuring differential pressure between two vertically spaced points. Differential pressure between these two points varies in direct proportion to density of the mud. This pressure is recorded in pounds per gallon on a 24-hour circular chart (see Fig. 48).

H. Gas-detection equipment.

Although gas-detection equipment is of some aid in abnormal pressure zones, its value is similar to that of the weight-recording instruments. That is, by the time it shows an increase in the gas in the mud, the kick has had time to increase in intensity. Chief value of the gas detectors would be in determining the duration, intensity, and type of swabbed or drilled shows.

Now for some SAFETY MEASURES

A. Things which reduce hazard of fire.

1. The electric lighting system should be vaporproof. Lights around the shaleshaker and flow line should be well protected so that they can't break and start a fire or explosion.

2. All open fires around a power rig should immediately be extinguished when the well starts to kick. The same is true when making a drill-stem test. On a steam rig, decision to put out the fires under the boilers will depend on direction of the wind and how much gas there is.

3. Allow no smoking around a rig when the well is kicking or when making a drill-stem test.

4. Motor exhausts should have spark suppressors.

5. Cars, boats, and firearms should be kept at a safe distance from a kicking or blowing well.

6. Air intakes on diesel engines should have a positive cutoff. These engines run wild and burn if gas is drawn into the air intake.

B. Blowout drills.

The tool pusher should call occasional blowout drills. This will make sure that each member of the crew knows what is happening, and what his job is in case of a kick or blowout. Any new member of a crew should be told what his duties are if a kick or blowout comes. He should take part in a blowout drill to make certain he has been properly instructed.

C. Miscellaneous safety measures.

1. Vent and choke lines should be well secured or tied down. They are often subjected to extremely high pressures. If not tied down, they may fly about, hurting someone or starting a fire. On drilling barges and offshore platforms, there should be vent lines run to each of opposite ends of the structure. Then, you will always be able to vent downwind.

2. Be careful when changing or nippling up preventers. It's easy to hurt someone seriously or to damage equipment. Toppling blowout preventers have killed several men; cause of these accidents was carelessness in putting on a chain or cable to pick up the preventers. Latch on the blowout-preventer assembly high up to keep it from toppling over. Some preventers have four lugs on the side; use these when picking up.

Keep fingers out from under the flanges when aligning the preventers. The drilling crew should get together with the welder and service-company personnel to coordinate the work before removing preventers and installing the christmas tree. Then, the job can usually be done faster and safer.

3. At isolated locations, and at all locations where you may drill abnormal pressures, keep a good supply of weight material on hand. At some locations, you may want to keep a supply of weighted, pumpable mud on hand.

4. When working around a well that could catch fire, wear asbestos clothing. In warm weather, it's hard to get men to wear the heavy asbestos. Yet, when the well ignites, there is usually injury and loss of life.

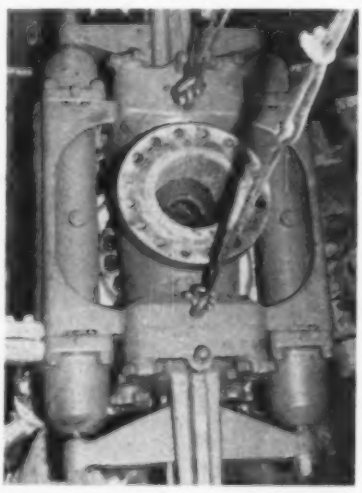


Fig. 49—Be careful when nippling up or changing preventers. Several men have been killed when preventers toppled because of careless handling.

The following is about the pattern of a burn received by a man when a well ignites: face, eyes, ears, hands, back, and sometimes back of the legs. This much burn is usually enough to be fatal. Chest and stomach seem to fare pretty well; this is probably due to a man's running in a crouched position as the tries to escape.

Likely, these burns could be averted of the men wore asbestos suits to protect the body, goggles to protect the eyes, and ear plugs to protect the ear drums. Ear plugs are also desirable if the well is making a lot of gas.

Acknowledgment

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Active Fields Report Drilling Data

by Norman S. Morrisey
Drilling-Development Editor

The Journal's Annual Drilling Survey gives the latest information about actual drilling conditions. This report includes all data necessary for current exploitation in these fields.

ONCE again the Journal gives its readers the annual drilling survey. These drilling reports include valuable data on contract drilling costs, casing programs, bit requirements, pay zones, completion practices, total days required to drill an average field well, etc.

These data are for typical field wells in each of the oil fields listed and are for average drilling conditions in the field. These reports will serve as a very useful guide in estimating well costs, setting up a drilling program, or even estimating payouts on proposed field wells. For more information prior to drilling or submitting bids, operators and contractors would undoubtedly check the data against offset wells. They would discuss the drilling and completion problems with engineers, tool pushers, and service companies, who are familiar with the local conditions.

The annual drilling survey is an exclusive feature and appears only in The Oil and Gas Journal. The results are based on a detailed survey of the most active oil fields in the United States and Canada.

This report includes timely drilling data about these fields . . .

Rocky Mountains

Montana . . . Blackfoot, Cabin Creek, Outlook, Pennell, Pine, Poplar.
North Dakota . . . Beaver Lodge, North Tioga.
Wyoming . . . Alkali anticline, Cottonwood Creek, Donkey Creek, East Salt Creek.
Denver basin . . . Akron (Colorado) and Gaylord (Nebraska).
Four Corners . . . Aneth Trend, Bisti, Red Wash, Tapacito.

Mid-Continent

Oklahoma . . . Carter-Knox, Cherokee Trend, East Noble, Keyes, Laverne, North Payne and Northeast Payne, Northeast Alden, Short Junction, Southeast Stockholm, Tatums.
Kansas . . . Antelope, Greenwood, Hugoton, Russell, Southwest Garfield, Spivey, Taloga, Windom.

Texas-New Mexico

West Texas . . . Andrews, Andrews South, Bakke, Deep Rock, Fuhrman-Mascho, Glasco-Devonian, Dune (San Andres), Noelke, Penwell, Goldsmith, Eskota (Noodle Creek), Homan, Garza, Howard-Glasscock, Boomerang (Pennsylvanian), Lee Harrison, Dora Roberts (Ellenburger), Howard Glasscock, Roaring Springs, Regular (Palo Pinto County), Ford (Delaware sand), Revilo (Glorieta), Regular (Shackelford County), Shipley (Queen), Kermit (Ellenburger), Brahaney, Prentice, Slaughter, Spraberry (Clearfork), Spraberry Trend, Arthur (Spraberry), TXL (Tubb), University Block 9, Watts (Gardner), Welch.
New Mexico . . . King (Devonian), Warren (McKee), North Gladiola, South High Lonesome.
South Texas . . . Danbury salt dome, Fashing (Edwards), High Island, Hull, Jaboncillos Creek, North Orange, Poesta Creek.
North Texas . . . Caughlin (Strawn), Regular (Baylor County).
East Texas . . . Day's Chapel, Longwood, Rodessa, Tatum.
Texas Panhandle . . . Hansford (Morrow), East Spearman, West Panhandle.

Louisiana

North . . . Calquitt, Greenwood-Waskom, Red Rock.
South . . . Bayou Choctaw, Bayou Penchant, Caillon Island, East Lake, Palourde, Montagut, West Hackberry.

Southeastern United States

Mississippi . . . Pistol Ridge-Maxie.
Tri-State area . . . Indiana, Illinois, Kentucky.

Canada

Alberta . . . Fenn-Big Valley, Harmattan, Kaybob, Keystone area, Pembina, Red Earth, Savana Creek.
British Columbia . . . Fort St. John.
Manitoba . . . North Virden, Virden-Roselea.
Saskatchewan . . . Carnduff, Hastings, Steelman-Hilrsch.

Rocky Mountains

BLACKFOOT FIELD
Glacier County, Montana

Pay zone	Madison
TD (avg.)	3,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$700.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	70
Per cent on day-work rate	30
Total days (spud to rig release)	10
Total number of bits	9

Equipment

Fuel: Diesel.
Water supply: Local ponds.
Nearest supply center: Cut Bank, Mont.
Terrain and roads: Hilly grass land.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	150	100
Oil string	5½	TD	200

Typical Mud Program

Material—	Amount
Gel, sacks	50
Driscose, sacks	5
Phosphate, sacks	5

Average Formation Tops

Formation—	Drilling depth (ft.)
Colorado	1,040
Kootenai	2,782
Sunburst	3,235
Cut Bank	3,266
Madison	3,454

CABIN CREEK FIELD
Fallon County, Montana

Pay zone	Mission Canyon limestone
TD (avg.)	7,400 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe*	$850.00
Day-work rate without drill pipe	$850.00

*Plus 1½ cents per foot per day rental for maximum amount of drill string used in each 24-hour period.

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	20
Total number of bits	24

Equipment

Fuel: Diesel.

Water supply: Water wells.
Nearest supply center: Glendive, Mont.
Terrain and roads: Rolling hills; main roads are oil surfaced.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,020	515
Oil string	5½	7,380	400

Remarks: Contractor furnishes cement and service for surface casing and runs 5½-in. casing on footage price.

Typical Mud Program

Material—	Amount
Lime, sacks	5
Zeogel, sacks	5
Lignox, sacks	5
Defoamer, sacks	1
Preservative, sacks	1
Plug-It, sacks	24
Q-Broxin, sacks	20
Tufplug, sacks	24
Oil, bbl.	355
Impermex, sacks	173
Salt, sacks	1,475

Average Formation Tops

Formation—	Drilling depth (ft.)
Spearfish	5,300
Charles	6,880
Mission Canyon	7,100

Remarks: Native mud and water to ±5,000 ft.; then convert to salt-saturated oil-emulsion mud. Completion rig is used to complete well.

CABIN CREEK FIELD
Fallon County, Montana

Pay zone: Siluro-Ordovician
TD (avg.): 9,120 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.35
Day-work rate with drill pipe	$1,100.00
Day-work rate without drill pipe	$1,000.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	33
Total number of bits	45

Equipment

Fuel: Diesel.
Water supply: Water wells.
Nearest supply center: Glendive, Mont.
Terrain and roads: Rolling hills; main roads are oil surfaced.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	1,020	375
Oil string	5½	9,100	830

Typical Mud Program

Material—	Amount
Controloid, sacks	170
Tufplug, sacks	148
Controlcal, sacks	30
Controgel, sacks	8
Fiber, sacks	45
Fibertex, sacks	5
Starch, sacks	36
Brinegel, sacks	72
Defoamer, sacks	3
Controlfoam, sacks	2
Salt, sacks	4,970
Oil, bbl.	770

Average Formation Tops

Formation—	Drilling depth (ft.)
Spearfish	5,300
Charles	6,880
Mission Canyon	7,100
Devonian	8,300
Silurian	8,325
Red River	8,850

Remarks: Native mud and water to ±5,000 ft.; then convert to salt-saturated oil emulsion mud. Completion rig is used to complete well.

OUTLOOK FIELD
Sheridan County, Montana

Pay zone: Outlook pay
TD (avg.): Varies, 9,000-10,000 ft.

Normal Rig-Time Distribution

Total days (spud to rig release)	45
Total number of bits	45

Equipment

Fuel: Butane.
Water supply: Water wells.
Nearest supply center: Culbertson, Mont.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	2,000	1,000
Oil string	7 or 5½	9,000-9,100	300-500

Average Formation Tops

Formation—	Drilling depth (ft.)
Outlook pay	9,000
Red River	9,900

Remarks: Operators use fresh water mud to 5,000 ft., then convert to a salt-saturated mud from 5,000 ft. to TD.

PENNEL FIELD
Fallon County, Montana

Pay zone: Siluro-Ordovician
TD (avg.): 8,800 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.75
Day-work rate with drill pipe	*$925
Day-work rate without drill pipe	$925

*Plus 1½ cents per foot drill pipe rental.

Normal Rig-Time Distribution

Per cent on footage rate	70
Per cent on day-work rate	30
Total days (spud to rig release)	55
Total number of bits	45

Equipment

Fuel: Diesel.
Water supply: Surface lake.
Nearest supply center: Glendive, Mont.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,700	700
Intermediate	7⅝	5,900	*260
Oil string	5½	8,750	200

*Salt-saturated Pozmix.

Typical Mud Program

Material—	Amount
Bentonite and salt gel, tons	18.6
Water-loss control, tons	9.8
Thinners, tons	13.0
Lost circulation, lb.	1,555
Salt, tons	60

Average Formation Tops

Formation—	Drilling depth (ft.)
Minnekahta	5,850
Mission Canyon	7,100
Devonian	8,100
Interlake	8,150
Stany Mountain	8,480
Red River	8,600

Remarks: High-pressure nitrogen gas around 5,850 ft. and salt encountered in drilling from 5,300 to 5,800 ft. are the principal drilling problems. Total mud bill averages $8,200.

PINE FIELD
Wibaux County, Montana

Pay zone: Siluro-Ordovician
TD (avg.): 9,130 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.35
Day-work rate with drill pipe	$1,100.00
Day-work rate without drill pipe	$1,000.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	33
Total number of bits	47

Equipment

Fuel: Diesel.
Water supply: Water wells.
Nearest supply center: Glendive, Mont.
Terrain and roads: Rolling hills; main roads are oil surfaced.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	1,020	350
Oil string	5½	9,120	850

Typical Mud Program

Material—	Amount
Salt, sacks	5,010
Lime, sacks	38
Impermex, sacks	429
Zeogel, sacks	235
Defoamer, sacks	6
Preservative, sacks	4
Mica, sacks	19
Oil, bbl.	725
Q-Broxin	60

Average Formation Tops

Formation—	Drilling depth (ft.)
Spearfish	5,300
Charles	6,875
Mission Canyon	7,375
Silurian	8,475
Red River	8,950

Remarks: Native mud and water to ±5,000 ft., then convert to salt-saturated oil-emulsion mud. Completion rig is used to complete well.

EAST POPLAR FIELD
Roosevelt County, Montana

Pay zone: Madison limestone
TD (avg.): 5,900 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.25
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$775.00

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	25
Total number of bits	15

Equipment

Fuel: Diesel.
Water supply: Poplar River runs through the field.
Nearest supply center: Williston, N. D., 76 miles east.
Terrain and roads: Rolling wheat land—rigs moved by skidding.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	150	200
Intermediate	9⅝	1,000	400
Oil string	5½	5,900	300

Remarks: 13⅜-in. set in river-bottom areas to seal off surface gravel.

Typical Mud Program

Material—	Amount
Weight material, sacks	700
Gel, sacks	140
Driscose, sacks	16
Caustic, lb.	4,700
Quebracho, lb.	6,400
Crude oil, bbl.	100

Average Formation Tops

Formation—	Drilling depth (ft.)
Judith River	750
Dakota	3,200
Piper lime	4,400
Amsden	4,800
Madison	5,500

BEAVER LODGE FIELD
Mountrail County, North Dakota

Pay zone: Madison limestone
TD (avg.): 8,300 ft.

Normal Rig-Time Distribution

Total days (spud to rig release)	23
Total number of bits	36

Equipment

Fuel: Gas.
Water supply: Water wells and ponds.
Nearest supply center: Field residue lime.
Terrain and roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	620	400
Oil string	5½ to 7	8,450 to 8,500	800

Average Formation Tops

Formation—	Drilling depth (ft.)
Madison	8,200 to 8,250

Remarks: Fresh water mud is used from surface to 5,000 ft. then operators convert to a salt-saturated mud from 5,000 ft. to TD.

NORTH TIOGA FIELD
Williams and Burke Counties, North Dakota

Pay zone: Madison limestone
TD (avg.): 8,100 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.50
Day-work rate with drill pipe	$910.00
Day-work rate without drill pipe	$790.00

Normal Rig-Time Distribution

Days on footage rate	32
Days on day-work rate	5
Total days (spud to rig release)	37
Total number of bits	35

Equipment

Fuel: Butane.
Water supply: Purchased, trucked.
Nearest supply center: Tioga and Williston, N. D.
Terrain and roads: Good terrain, fair roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	525
Oil string	5½	8,100	500

Typical Mud Program

Salt, sacks	1,085
Salt, gel, sacks	243
Gyp base, bentonite and clay, sacks	600
Soda ash, sacks	110
Crude oil, bbl.	350

Average Formation Tops

Formation—	Drilling depth (ft.)
Kibbey lime	7,070
Charles salt	7,220
Madison	7,750
Nesson	7,960

ALKALI ANTICLINE (TENSLEEP) FIELD
Wyoming

Pay zone: Tensleep, Phosphoria (Darwin—one well)
TD (avg.): 6,000 ft. (100 ft. in Tensleep)

Cost Averages, Per Ft. or Day

Footage price	$9.25
Day-work rate with drill pipe	$960.00
Day-work rate without drill pipe	$840.00

Normal Rig-Time Distribution

Per cent on footage rate	30
Per cent on day-work rate	70
Total days (spud to rig release)	60

Equipment

Fuel: Natural gas.
Water supply: 8 miles, hauling.
Nearest supply center: Worland, Wyo.
Terrain and roads: Terrain very rugged but only 1 mile from black-top road.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	250	175
Oil string	7	6,000	175

Average Formation Tops

Formation—	Drilling depth (ft.)
Frontier	1,850
Muddy	3,188
Gypsum Springs	4,690
Phosphoria	5,612
Tensleep	5,861

Remarks: A large percentage of these holes are drilled on day-work by virtue of a deviation clause in the contracts. Average mud bill runs 60 cents per foot.

COTTONWOOD CREEK FIELD
Washakie County, Wyoming

Pay zone: Phosphoria
TD (avg.): 8,350 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.50
Day-work rate with drill pipe	$875.00
Day-work rate without drill pipe	$975.00

Normal Rig-Time Distribution

Per cent on footage rate	99
Per cent on day-work rate	1
Total days (spud to rig release)	58
Total number of bits	53

Equipment

Fuel: Butane.
Water supply: Big Horn River (15 miles).
Nearest supply center: Worland, 15 miles.
Terrain and roads: Rolling; good roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	350	350
Oil string	7	8,350	350

Typical Mud Program

Material—	Amount
Gel, sacks	300
Barium carbonate, sacks	100
Quebracho, sacks	25
Phosphate, sacks	5
Lost-circulation material, sacks	25

Average Formation Tops

Formation—	Drilling depth (ft.)
Muddy	6,200
Gypsum Springs	7,200
Curtis	7,350
Phosphoria	8,200

DONKEY CREEK FIELD
Creek County, Wyoming

Pay zone: Dakota sandstone
TD (avg.): 6,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$750.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	15
Total number of bits	9

Equipment

Fuel: Gas in field.
Water supply: Water wells.
Nearest supply center: Newcastle and Casper, Wyo.
Terrain and roads: Rolling, dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	150-500	150-200
Oil string	5½ or 7	6,500	100-400

Average Formation Tops

Formation—	Drilling depth (ft.)
Niobrara	4,600
Muddy	6,200
Lakota	6,450
Dakota	6,550

Remarks: Operators drill with water from surface to 5,000 ft., then convert to an oil-emulsion mud.

EAST SALT CREEK FIELD
Natrona County, Wyoming

Pay zone	Tensleep sand
TD (avg.)	7,600 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.75
Day-work rate with drill pipe	$900.00
Day-rate rate without drill pipe	$800.00

Normal Rig-Time Distribution

Per cent on footage rate	63
Per cent on day-work rate	37
Total days (spud to rig release)	56

Equipment

Fuel: Company source.
Water supply: Contractor.
Nearest supply center: Casper, Wyo.
Terrain and roads: Rolling, roads good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	310	300
Oil string	7	7,600	575

Typical Mud Program

Material—	Amount
Gel, sacks	917
Gypsum, sacks	85
Lost-circulation material, lb.	3,350
Chemical, lb.	4,850

Average Formation Tops

Formation—	Drilling depth (ft.)
Frontier	4,330
Dakota	5,860
Morrison	6,005
Sundance	6,165
Tensleep	7,432

AKRON FIELD
Washington County, Colorado

Pay zone	"D" sand
TD (avg.)	4,640 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.25
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	600.00

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	6
Total number of bits	3

Equipment

Nearest supply center: Sterling (30 miles).
Terrain and roads: Level and good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	242	150
Oil string	5½	4,642	125

Typical Mud Program

Material—	Amount
Magcogel, tons	3.65
Soda ash, lb.	300
Caustic soda, lb.	300
Quebracho, lb.	450
Lime, lb.	200
Hulls, bags	3

Average Formation Tops

Formation—	Drilling depth (ft.)
Niobrara	3,620
Timpas	4,056
Greenhorn	4,244
D sandstone	4,525
J sandstone	4,608

GAYLORD FIELD
Nebraska

Pay zone	"J" sand of Dakota series
TD (avg.)	5,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.50
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	86
Per cent on day-work rate	14
Total days (spud to rig release)	7
Total number of bits	4 to 5

Equipment

Nearest supply center: Sidney or Kimball, Neb.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	400-500	250
Oil string	5½	5,300	150

Remarks: Some lost-circulation problem.

Average Formation Tops

Formation—	Drilling depth (ft.)
Nebraska	4,300
Carlile	4,650
"D"	5,100
"J"	5,250
Skull Creek	5,350

ANETH TREND
San Juan County, Utah

Pay zone	Paradox limestone
TD (avg.)	5,800 ft.

Cost Averages, Per Ft. or Day

Footage price	$8.50
Day-work rate with drill pipe	$875.00
Day-work rate without drill pipe	$825.00

Normal Rig-Time Distribution

Per cent on footage rate	60
Per cent on day-work rate	40
Total days (spud to rig release)	38
Total number of bits	30

Equipment

Fuel: Diesel.
Water supply: Truck.
Nearest supply center: Cortez, Colo.; Farmington, N. M.
Terrain and roads: Rough terrain, poor roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	50	100
Intermediate	10¾	1,250	1,000
Oil string	5¼ to 7	5,800	500

Typical Mud Program

Material—	Amount
Bentonite, sacks	350
Caustic soda, lb.	830
Quebracho, lb.	1,550
Crude oil, bbl.	60
Barite, sacks	100
Starch, sacks	5
Driscose, sacks	25
Gypsum, lb.	2,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Paradox	5,700

RED WASH FIELD
Uintah County, Utah

Pay zone	Lower Green River-Eocene
TD (avg.)	5,800 ft.

Normal Rig-Time Distribution

Per cent on footage rate	60
Per cent on day-work rate	40
Total days (spud to rig release)	32
Total number of bits	20

Equipment

Fuel: Natural gas.
Water supply: Green River.
Nearest supply center: Vernal, Utah.
Terrain and roads: Unimproved—rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	225	180
Intermediate	7 comb.	5,800	500

Average Formation Tops

Formation—	Drilling depth (ft.)
Green River	2,800
Wasatch	6,000

BISTI FIELD
San Juan County, New Mexico

Pay zone	Gallup sand
TD (avg.)	5,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50-$4.00
Day-work rate with drill pipe, per hour	$29.17
Day-work rate without drill pipe, per hour	$27.08

Normal Rig-Time Distribution

Per cent on footage rate	60
Per cent on day-work rate	40
Total days (spud to rig release)	22-23
Total number of bits	10-13

Equipment

Fuel: Gas or butane.
Water supply: Haul from river.
Nearest supply center: Farmington, N. M.
Terrain and roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	200-300	200-300
Oil string	5½	5,000	150-200

TAPACITO FIELD
San Juan Basin, New Mexico

Pay zone	Mesaverde and Pictured Cliff (dual completions)
TD (avg.)	6,200 ft.

Cost Averages, Per Ft. or Day

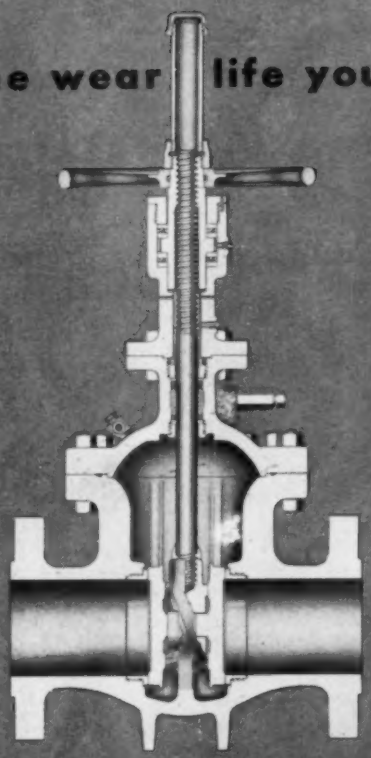
Footage price	$4.50
Day-work rate with drill pipe	$800.00
Day-work rate without drill pipe	$725.00

Normal Rig-Time Distribution

Per cent on footage rate	70
Per cent on day-work rate	30
Total days (spud to rig release)	30
Total number of bits	14

New CRANE Double-Disc Valve

has the wear life you want on pipeline service



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Available in sizes 4 to 24 inches; flanged ends (No. 1680) or butt-welding ends (No. 1681). Either spur or bevel gearing can be provided. For full details, see your local Crane Representative or write to address below.

Developed for both oil and gas transmission, this new Crane gate valve has the long-wear features you want for steady, trouble-free service in your lines.

This new Crane valve design has free-to-rotate double discs—hung independently to change seating position with every operation. Each time this valve is opened or closed, both discs are free to turn to provide cleaning action on seating contact areas, and thus prevent abrasive materials from collecting.

Disc clearances are always accurate, because the two identical discs move up and down in machined body-guide ribs—which take the service abuse usually forced on disc faces in conventional double-disc gate valves, a frequent cause of damage and costly maintenance.

Consider and compare, too, the perfect disc alignment in this smooth-working Crane pipeline valve. Annular-shaped machined wedging surfaces keep both discs and the body ring seat faces lined up at all times—and, in addition, compensate for any slight body deflections caused by line strains.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches & Wholesalers Serving All Areas

Equipment

Fuel: Natural gas.
Water supply: Wells.
Nearest supply center: Farmington, N. M.
Terrain and roads: Mountainous; dirt.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	350	
Intermediate	7⅝	4,200	
Oil string	5½ (Liner)	6,200	

Average Formation Tops

Formation—	Drilling depth (ft.)
Pictured Cliff	3,800
Cliff House	5,600
Point Lookout	5,900
Mancos	6,100

Remarks: Fresh water mud to 4,200 ft. Gas to total depth. Mud costs $3,000 per well.

Mid-Continent

CARTER-KNOX FIELD
Brady County, Oklahoma

Pay zone: Bromide sands
TD (avg.): 16,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$11.78
Day-work rate with drill pipe	$1,250.00
Day-work rate without drill pipe	$1,000.00

Normal Rig-Time Distribution

Per cent on footage rate	39
Per cent on day-work rate	61
Total days (spud to rig release)	250
Total number of bits	181

Equipment

Fuel: Gas.
Water supply: Wells.
Nearest supply center: Lindsay, Okla.
Terrain and roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	4,000	3,600
Oil string	7	15,100	1,200

Remarks: Completion will be in open hole or through 5-in. liner.

Typical Mud Program

Material—	Amount
Weight, sacks	44,923
Gel, sacks	4,225
Lost circulation, lb.	32,000
Chemicals, lb.	177,450
Oil, bbl.	3,900

Average Formation Tops

Formation—	Drilling depth (ft.)
County Line lime	3,700
Bromide Dense	15,000
Second Bromide	15,350
Third Bromide	15,500

CHEROKEE TREND
Grant County, Oklahoma

Pay zone: Basal Pennsylvanian sand
TD (avg.): 5,050 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.15-$4.50
Day-work rate with drill pipe	$600.00-$750.00
Day-work rate without drill pipe	$550.00-$650.00

Normal Rig-Time Distribution

Per cent on footage rate	94
Per cent on day-work rate	6
Total days (spud to rig release)	15
Total number of bits	14

Equipment

Fuel: Butane and gas.
Water supply: Ponds and water wells.
Terrain and roads: Sandy terrain, roads good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	250	250
Oil string	4½-5½	5,000	150

Typical Mud Program

Material—	Amount
Magcogel, tons	7.2
Cottonseed hulls, tons	3.45
Lime, lb.	100
Salt gel, tons	11.80
High yield clay, lb.	200
Mud fiber, lb.	760
My-Lo-Gel, lb.	2,750
My-Lo-Gel pres., lb.	300

Average Formation Tops

Formation—	Drilling depth (ft.)
Layton	4,350
Big Lime	4,450
Basal Pennsylvanian or Cherokee pay	4,950
Mississippi lime	5,000

EAST NOBLE FIELD
Cleveland County, Oklahoma

Pay zone: Bromide, Viola and Tulip Creek
TD (avg.): 7,400 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.00
Day-work rate with drill pipe	$700.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	40
Total number of bits	40

Equipment

Fuel: Lease, gas and butane.
Water supply: Wells.
Nearest supply center: Oklahoma City.
Terrain and roads: Rolling, gravel.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	725	500
Oil string	5½	7,500	700

Typical Mud Program

Material—	Amount
Gel, tons	65
Caustic, lb.	1,800
Chemicals, lb.	8,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Bartlesville	6,675
Hunton	6,800
Sylvan shale	7,000
Viola	7,100
Bromide	7,450

KEYES GAS FIELD
Cimarron County, Oklahoma

Pay zone: Keyes sand
TD (avg.): 4,700 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.00
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	16
Total number of bits	18

Equipment

Fuel: Butane.
Water supply: $1,000 (Haul from Keyes, Okla., or from irrigation well).
Nearest supply center: Liberal, Kans.
Terrain and roads: Level.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	1,600	750
Oil string	5½	4,700	250

Typical Mud Program

Material—	Amount
Gel, sacks	350
Hulls, sacks	300
Fiber, sacks	100
Chemical, sacks	20

Average Formation Tops

Formation—	Drilling depth (ft.)
Top Tubb	1,500
Top Neva	2,700
Base Cherokee shale	3,900
Morrow (Keyes sand)	4,600
Top Miss.	4,700

LAVERNE FIELD
Harper County, Oklahoma

Pay zone: Multiple pays: Hoover, Tonkawa, Morrow, and Chester
TD (avg.): 7,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.50
Day-work rate with drill pipe, per hour	$31.25
Day-work rate without drill pipe, per hour	$27.08

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day-work rate	15
Total days (spud to rig release)	27-28

Equipment

Fuel: Gas.
Water supply: Water wells.
Nearest supply center: Liberal.
Terrain and roads: Level, sandy in river bottom.

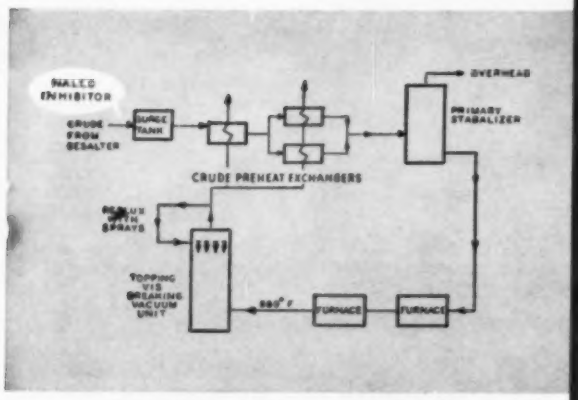
Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	500	550
Intermediate	9⅝	3,000	250
Oil string	7	7,500	150

Nalco INHIBITORS STOP CORROSION and FOULING

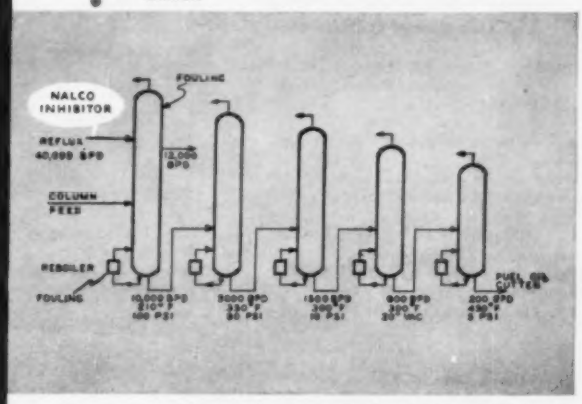
Every Step of the Way

HERE are four typical stages of refinery production where Nalco Inhibitors stop corrosion and fouling. There are many others, too. In fact Nalco Inhibitors are effective every step of the refinery way. Ask your Nalco Representative or write direct.



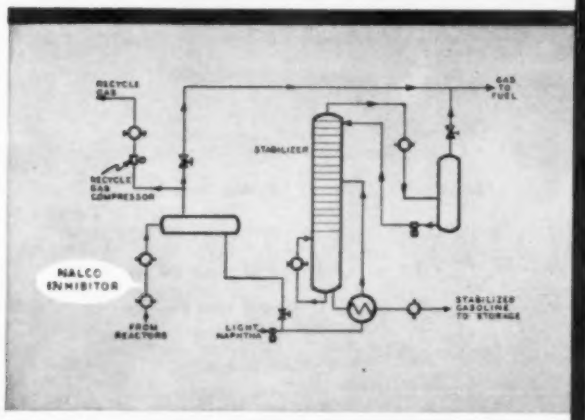
CRUDE PREHEAT EXCHANGERS

The Problem: Fouling. *The Treatment:* 15 ppm of Nalco Inhibitor. *The Results:* Normal temperatures regained in exchangers after five weeks of treatment. Actual reduction of 4 days of downtime due to cleaner condition of treated units.



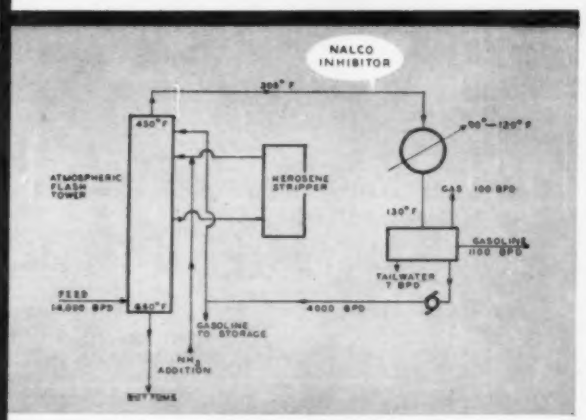
ALKYLATION SYSTEM

The Problem: Reboiler fouling. *The Treatment:* Nalco Inhibitor fed to reflux of left tower. *The Results:* No water washing or mechanical cleaning of system needed after full year of operation. Refinery costs and inconvenience reduced considerably. Greater production realized.



PLATINUM REFORMING UNIT

The Problem: Severe corrosion of exchangers and accumulator after the reactors due to an unusually high halogen acid contamination which held pH about 1.3. *The Treatment:* Nalco Inhibitor into reactor effluent. *The Results:* Iron content reduced from 13.9 to low of 0.73 lbs. per day, far lower than with other inhibitors at greater dosage.



DELAYED COKING UNIT

The Problem: Corrosion of overhead condenser, accumulator and stream pumps. Small amounts of iron sulfide "scaling" in flash tower. *The Treatment:* Nalco Inhibitor added to overhead stream. *The Results:* Iron content of tail water reduced from 300-1000 ppm to approximately 1-20 ppm. Corrosion and scaling stopped.

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THE Nalco® SYSTEM . . . *Serving Industry through Practical Applied Science*

Remarks: Occasionally use 100 ft. of 18-in. conductor pipe.

Average Formation Tops

Formation—	Drilling depth (ft.)
Hoover	4,100
Tonkawa	5,690
Morrow	7,370
Chester	7,450

NORTH PAYNE AND NORTHEAST PAYNE FIELDS
McClain County, Oklahoma

Pay zone: Hart sand, Hunton (Bois d'Arc) lime, and Bromide sands
TD (avg.): 10,412 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.00
Day-work rate with drill pipe	$950.00
Day-work rate without drill pipe	$850.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	52
Total number of bits	57

Equipment

Fuel: Natural gas.
Water supply: Pond.
Nearest supply center: Offset well.
Terrain and roads: Level.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	605.85	400
Oil string	7	Through pay	

Average Formation Tops

Formation—	Drilling depth (ft.)
Hart sand	8,440
Mayes	8,900
Woodford	9,000
Hunton	9,150
Bromide	10,250

NORTHEAST ALDEN FIELD
Caddo County, Oklahoma

Pay zone: Bromide sand
TD (avg.): 9,344 ft.

Cost Averages, Per Ft. or Day

Footage price	$13.50
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$800.00

Normal Rig-Time Distribution

Per cent on footage rate	81.03
Per cent on day-work rate	18.97
Total days (spud to rig release)	150

Equipment

Fuel: Contractor.
Water supply: Contractor.
Nearest supply center: Cement, Okla.
Terrain and roads: Level.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	1,007	1,000
Oil string	7	9,264	575

Typical Mud Program

Material—	Amount
Aquagel, lb.	306,400
Barite, lb.	187,367
Quebracho, lb.	28,850
Caustic soda, lb.	17,733
Soda ash, lb.	1,667
Special chemicals, lb.	21,163

Average Formation Tops

Formation—	Drilling depth (ft.)
Springer	2,318
Sycamore	3,490
Woodford	6,165
Hunton	6,945
Sylvan	7,688
Viola	7,885
First Bromide	8,862
Second Bromide	8,925

SHORT JUNCTION FIELD
Cleveland County, Oklahoma

Pay zone: Bois d'Arc limestone and Bartlesville sand
TD (avg.): 8,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$900.00
Day-work rate without drill pipe	$800.00

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day-work rate	15
Total days (spud to rig release)	35
Total number of bits	30

Equipment

Fuel: Gas or diesel.
Water supply: 8.00 per day.
Nearest supply center: Oklahoma City.
Terrain and roads: Flat and good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	850	650
Oil string	5½	7,980	500

Typical Mud Program

Material—	Amount
Tannathin, lb.	6,250
Caustic soda, lb.	2,315
Magcogel, lb.	47,000
Soda ash, lb.	720
Oil, bbl.	230

Average Formation Tops

Formation—	Drilling depth (ft.)
Prue	7,350
Pink lime	7,500
Bartlesville	7,660
Hunton	7,690
Harrigan	7,764

SOUTHEAST STOCKHOLM FIELD
Harper County, Oklahoma

Pay zone: Lower Tonkawa
TD (avg.): 5,560 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.60
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	60

Equipment

Fuel: Diesel.
Water supply: Ponds.
Nearest supply center: Oklahoma City.
Terrain and roads: Level terrain. Roads fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	600	500
Oil string	5½	5,600	150

Typical Mud Program

Material—	Amount
Gel, sacks	650
Clay, sacks	125
Salt gel, sacks	700
Mud fiber, sacks	40
Preservative, sacks	30

Average Formation Tops

Formation—	Drilling depth (ft.)
Virgil	2,142
Hoover	4,122
Oread	5,044
Lower Tonkawa	5,488
Upper Tonkawa	5,303

Remarks: Lost circulation can be a major and costly problem.

TATUMS FIELD
Carter County, Oklahoma

Pay zone: Goodwin sand (Springer)
TD (avg.): 3,200 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.00
Day-work rate with drill pipe	$550.00
Day-work rate without drill pipe	$500.00

Normal Rig-Time Distribution

Per cent on footage rate	99
Per cent on day-work rate	1
Total days (spud to rig release)	18
Total number of bits	24

Equipment

Fuel: Natural gas.
Water supply: Surface ponds and wells.
Nearest supply center: Healdton, Okla.
Terrain and roads: Fair to slightly rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	130	90
Oil string	5½	3,200	200

Typical Mud Program

Material—	Amount
Gel, tons	9
Quebracho, lb.	2,000
Caustic, lb.	1,500
Ligco, lb.	1,000
Avg. lost circulation material	1,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Base of Pontotoc	600
Top Springer shale	600
Markham sand S.W.	700
Sims sand gas	2,000
Goodwin sand oil	3,000

Remarks: Crooked hole problem in Springer shale and lost circulation at top of Goodwin sand in 75 per cent of holes drilled.

ANTELOPE FIELD
Marion County, Kansas

Pay zone: Mississippian
TD (avg.): 2,345 ft.

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Cost Averages, Per Ft. or Day

Footage price	$2.75
Day-work rate with drill pipe	$20.00

Normal Rig-Time Distribution

Per cent on footage rate	99
Per cent on day-work rate	1
Total days (spud to rig release)	4
Total number of bits	5-6

Equipment

Fuel: Diesel.
Water supply: Good.
Nearest supply center: Marion, Kans.
Terrain and roads: Gentle rolling—fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	225	200
Oil string	4½	2,335	50

Average Formation Tops

Formation—	Drilling depth (ft.)
Mississippian	2,333

Remarks: Little or no additives used for mud system.

GREENWOOD FIELD
Morton County, Kansas

Pay zone	Greenwood
TD (avg.)	3,273 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.75
Day-work rate with drill pipe	$500.00
Day-work rate without drill pipe	$450.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	8
Total number of bits	7

Equipment

Fuel: Butane.
Water supply: Trucking (10 to 20 miles).
Nearest supply center: Liberal, Kans.
Terrain and roads: Level—good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝ and 7	603	300
Oil string	5½ and 4½	3,273	300

Typical Mud Program

Material—	Amount
Salt gel, sacks	100
Fiber, sacks	45
Soda ash, sacks	8
Lime, sacks	4
Hulls, sacks	97

Average Formation Tops

Formation—	Drilling depth (ft.)
Wabaunsee	2,647
Topeka	2,858
Lansing	3,107

HUGOTON FIELD
Western Kansas Portion

Pay zone	Herington-Krider
TD (avg.)	2,597 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.90
Day-work rate with drill pipe	$480.00
Day-work rate without drill pipe	$400.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	5
Total number of bits	4

Equipment

Fuel: $200 per well.
Water supply: Trucked.
Nearest supply center: Liberal, Kans.
Terrain and roads: Flat, roads fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	385	200
Oil string	4½	2,595	(*)

Remarks: *950 cu. ft. of 65 per cent Stratacrete, 35 per cent gel; plus 100 cu. ft. of 50 per cent Stratacrete, 50 per cent cement, 4 per cent gel.

Typical Mud Program

Material—	Amount
Gel Bentonite, sacks	32
Salt mud, sacks	6
Starch, sacks	29
Cottonseed hulls, sacks	15
Lime, sacks	2

Average Formation Tops

Formation—	Drilling depth (ft.)
Krider	2,632
Herington	2,599

RUSSELL FIELD
Russell County, Kansas

Pay zone	Lansing, Kansas City, and Arbuckle dolomite
TD (avg.)	3,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$480.00
Day-work rate without drill pipe	$480.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	11
Total number of bits	10

Equipment

Fuel: Diesel.
Water supply: Surface ponds.
Nearest supply center: Russell, Kans.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	300 to 900	125 to 425
Oil string	5½	3,300	75

Remarks: Operators sometimes run 7-in. or 4½-in. for production string.

Typical Mud Program

Material—	Amount
Gel, sacks	38
Fiber, sacks	7
Salt mud, sacks	35
Starch, sacks	55
Hulls, sacks	33

Average Formation Tops

Formation—	Drilling depth (ft.)
Topeka lime	2,750
Hubner shale	2,980
Toronto lime	3,000
Lansing-Kansas City lime	3,025
Arbuckle dolomite	3,300

SOUTHWEST GARFIELD FIELD
Pawnee County, Kansas

Pay zone	Mississippian—Pennsylvanian contact
TD (avg.)	4,375 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.25
Day-work rate with drill pipe	$520.00
Day-work rate without drill pipe	$480.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	14
Total number of bits	11-12

Equipment

Fuel: $34 per day.
Water supply: Well.
Nearest supply center: Great Bend, Kans.
Terrain and roads: Sandhills—rolling.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	240-260	175-200
Oil string	5½	4,375-4,400	150

Typical Mud Program

Material—	Amount
Controlgel bentonite, tons	1.10
Controload, lb.	3,350.00
Brinegel, tons	1.32
Cottonseed hulls, lb.	2,600.00
Paraformaldehyde, lb.	100.00

Average Formation Tops

Formation—	Drilling depth (ft.)
Heebner	3,690-3,700
Lansing-Kansas City	3,810-3,820
Shaly conglomerate	4,210-4,220
Chert (conglomerate-Mississippi)	4,230-4,240
Viola	4,360-4,400

SPIVEY FIELD
Kingman County, Kansas

Pay zone	Mississippian
TD (avg.)	4,360 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.32
Day-work rate with drill pipe, per hour	$20.00
Day-work rate without drill pipe, per hour	$18.75

Normal Rig-Time Distribution

Total days (spud to rig release)	15

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	240	165
Oil string	5½	4,424	75

Typical Mud Program

Material—	Amount
Controloid, sacks	108
Controlgel bentonite, sacks	45
Brinegel, sacks	109
Hulls, sacks	36
Lime, sacks	2
Soda ash, sacks	4

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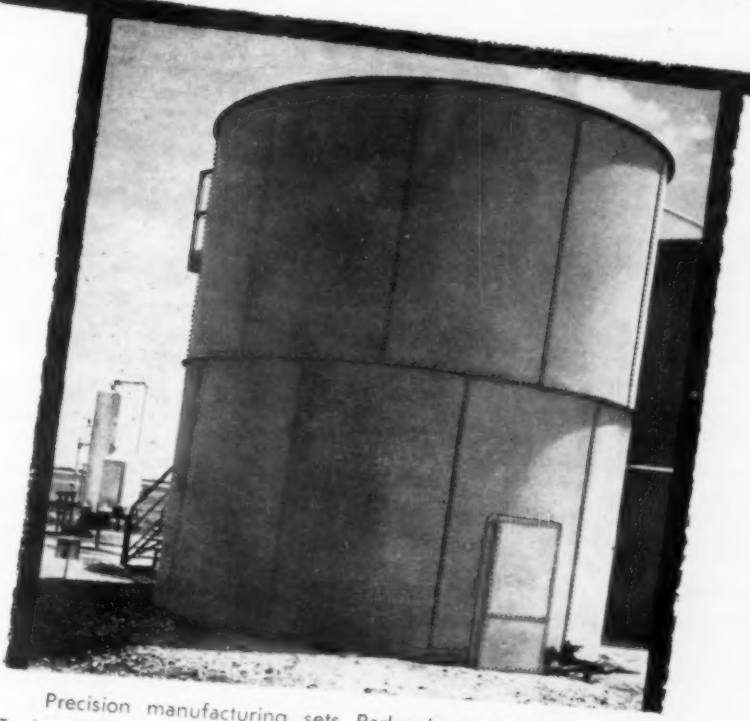

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Average Formation Tops

Formation—	Drilling depth (ft.)
Heebner	3,233
Lansing	3,447
Mississippian	4,196

TALOGA FIELD
Morton County, Kansas

Pay zone "Keyes" sand (Morrow), Morrow "Keyes" sand
TD (avg.) 4,630 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.90
Day-work rate with drill pipe	$550.00
Day-work rate without drill pipe	$500.00

Normal Rig-Time Distribution

Per cent on footage rate	92
Per cent on day-work rate	8
Total days (spud to rig release)	16
Total number of bits	10

Equipment

Fuel: Butane.
Water supply: Truck in.
Nearest supply center: Liberal, Kans.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝-7	1,500	800
Oil string	5½-4½	4,627	150

Typical Mud Program

Material—	Amount
Gel, sacks	547
Lignite, sacks	72
Fiber, sacks	218
Hulls, sacks	300
Soda ash, lb.	46

Average Formation Tops

Formation	Drilling depth (ft.)
Morrow shale	4,132
U. Morrow	4,176
L. Morrow	4,513
Morrow "Keyes" sand	4,551
Mississippian	4,579

WINDOM FIELD
McPherson County, Kansas

Pay zone Miss. chat and Miss. cong. chert
TD (avg.) 3,450 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	88
Per cent on day-work rate	12
Total days (spud to rig release)	10
Total number of bits	10

Equipment

Fuel: Local supply.
Water supply: Trucks (no well water).
Nearest supply center: McPherson.
Terrain and roads: Level to rolling.

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	215	100
Oil string	5½	3,450	125

Average Formation Tops

Formation—	Drilling depth (ft.)
Lansing	2,800
Miss. cong. chert	3,575
Mississippi	3,400

Remarks: This area has much harder drilling below the Miss. top to Arbuckle. Five additional days—500 ft. (3,900 ft.); competitive price $3.85 per ft. Little or no present production below upper 50 ft. of the Mississippi in this immediate area.

Texas-New Mexico

ANDREWS—PENNSYLVANIAN FIELD
Andrews County, Texas

Pay zone Pennsylvanian
TD (avg.) 9,200 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.75
Day-work rate with drill pipe	$950.00
Day-work rate without drill pipe	$900.00

Normal Rig-Time Distribution

Per cent on footage rate	70
Per cent on day-work rate	30
Total days (spud to rig release)	70
Total number of bits	35

Equipment

Fuel: Gas.
Water supply: Field wells or hauling.
Nearest supply center: Andrews, Tex.
Terrain and roads: Flat terrain, gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	450	450
Intermediate	9⅝	5,000	2,300
Oil string	7⅝ (liner)	9,300	875

Typical Mud Program

Salt-water mud to 9⅝-in. casing seat. Clear water to 800 ft. Lime-base emulsion mud with 40 seconds viscosity; 8.9 lb. per gal. density and 10 cc. water loss to total depth. (Mud costs: $5,000 per well.)

Average Formation Tops

Formation—	Drilling depth (ft.)
Rustler	1,900
San Andres	4,650
Lower Spraberry	8,275
Wolfcamp	8,525
Pennsylvanian	8,930

ANDREWS, SOUTH (WOLFCAMP)
Andrews County, Texas

Pay zone Wolfcamp
TD (avg.) 9,033 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.50
Day-work rate with drill pipe	$950.00
Day-work rate without drill pipe	$850.00

Normal Rig-Time Distribution

Per cent on footage rate	82½
Per cent on day-work rate	17½
Total days (spud to rig release)	57½
Total number of bits	57

Equipment

Fuel: Butane (furnished).
Water supply: Furnished.
Nearest supply center: 30 miles.
Terrain and roads: Level and good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	493	438
Intermediate	8⅝	4,539	1,434
Oil string	5½	9,025	290
Tubing	2⅜	8,697	

Typical Mud Program

Material—	Amount
Salt, sacks	101
Gel, sacks	334
Caustic, lb.	875
Driscose, sacks	229
Soda ash, sacks	18

Average Formation Tops

Formation—	Drilling depth (ft.)
Wolfcamp	8,750

BAKKE (ELLENBURGER) FIELD
Andrews County, Texas

Pay zone Ellenburger
TD (avg.) 12,430 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.65
Day-work rate with drill pipe	*$950.00
Day-work rate without drill pipe	$950.00

*Plus 1½ cents per foot drill pipe rental.

Normal Rig-Time Distribution

Per cent on footage rate	68
Per cent on day-work rate	32
Total days (spud to rig release)	89
Total number of bits	90

Equipment

Fuel: Field residue.
Water supply: Lease wells.
Nearest supply center: Andrews, Tex.
Terrain and roads: Flat.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	200	250
Intermediate	9⅝	4,675	1,900
Oil string	7	12,430	700

Typical Mud Program

Material—	Amount
Impermix, sacks	50
Quebracho	130
Fibertex, sacks	200
Caustic soda, sacks	65
Soda ash, sacks	30

Average Formation Tops

Formation—	Drilling depth (ft.)
Devonian	10,468
Ellenburger	12,282

BAKKE (WOLFCAMP) FIELD
Andrews County, Texas

Pay zone Wolfcamp limestone (8,500-8,650 ft.) and Pennsylvanian
TD (avg.) 9,300 to 9,750 ft. (See remarks)

Cost Averages, Per Ft. or Day

Footage price	$6.00-$6.25
Day-work rate with drill pipe	$975.00-$1,075.00
Day-work rate without drill pipe	$875.00-$950.00

Normal Rig-Time Distribution

Per cent on footage rate	70-90
Per cent on day-work rate	10-30
Total days (spud to rig release)	40-60
Total number of bits	45-97½

Equipment

Fuel: Natural gas.
Water supply: Subsurface sands, water wells.
Nearest supply center: Andrews, 4 miles.
Terrain and roads: Terrain flat—roads excellent.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	200	200
Intermediate	9⅝	4,800	1,600
Oil string	7 or 5½	9,300 to 9,750	700

Typical Mud Program

Material—	Amount
Salt, bbl.	3,500
Bentonite, sacks	1,000
Driscose, sacks	50
Diesel oil, bbl.	±500

Average Formation Tops

Formation—	Drilling depth (ft.)
Rustler anhydrite	1,900
Grayburg	4,600
San Andres	4,800
Wolfcamp	8,500

Remarks: All wells drilled to date in this field are dual completions in Bakke Wolfcamp and Bakke Pennsylvanian fields. Day work depends upon amount of coring and testing. Salt-saturated mud is used to 4,800 ft.

DEEP ROCK (ELLENBURGER) FIELD
Andrews County, Texas

Pay zone	Ellenburger limestone
TD (avg.)	12,200 ft.

Cost Averages, Per Ft. or Day

Footage price	$9.00
Day-work rate with drill pipe	(*)
Day-work rate without drill pipe	(†)

*0-10,000 ft., $900.00; 10,000 ft.-TD, $1,000. †0-10,000 ft., $800.00; 10,000 ft.-TD, $900.00.

Normal Rig-Time Distribution

Per cent on footage rate	69.5
Per cent on day-work rate	30.5
Total days (spud to rig release)	93

Equipment

Fuel: Gas or L.P.G.
Water supply: Purchased from contractor.
Nearest supply center: Odessa, Tex.
Terrain and roads: Level, sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	400	500
Intermediate	8⅝	4,500	3,000
Oil string	5½	12,175	1,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Devonian	10,100-10,145
Ellenburger	12,150-12,250

FUHRMAN-MASCHO FIELD
Andrews County, Texas

Pay zone	San Andres
TD (avg.)	4,450 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.90
Day-work rate with drill pipe	$300.00
Day-work rate without drill pipe	$375.00

Normal Rig-Time Distribution

Total days (spud to rig release)	28

Equipment

Fuel: L.P.G.
Water supply: Purchased or drilled water wells.
Nearest supply center: Odessa, Tex.
Terrain and roads: Smooth, level terrain and roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	250	200
Oil string	5½	4,490	400

Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	4,400-4,500

GLASCO-DEVONIAN FIELD
Andrews County, Texas

Pay zone	Devonian
TD (avg.)	12,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.75
Day-work rate with drill pipe	(*)
Day-work rate without drill pipe	(†)

*0-10,000 ft., $900.00; 10,000 ft.-TD, $1,000. †0-10,000 ft., $800.00; 10,000 ft.-TD, $900.00.

Normal Rig-Time Distribution

Per cent on footage rate	82
Per cent on day-work rate	5
Total days (spud to rig release)	79

Equipment

Fuel: L.P.G.
Water supply: Purchased from contractor.
Nearest supply center: Odessa, Tex.
Terrain and roads: Level, sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	400	350
Intermediate	8⅝	4,900	3,000
Oil string	5½	12,500	400

Average Formation Tops

Formation—	Drilling depth (ft.)
Spraberry	8,580-8,680
Strawn	11,120-11,250
Devonian	12,490-12,520

DUNE (SAN ANDRES) FIELD
Crane County, Texas

Pay zone	Grayburg-San Andres
TD (avg.)	3,600 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	(*)
Per cent on day-work rate	(*)
Total days (spud to rig release)	12
Total number of bits	8-10

*Depends on amount of coring.

Equipment

Fuel: Purchased.
Water supply: Water wells.
Nearest supply center: Odessa.
Terrain and roads: Sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	40	
Oil string	5½	3,600±	Variable

Remarks: Most operators set 800 to 1,000 ft. of surface; but do not circulate cement on their oil string.

Average Formation Tops

Formation—	Drilling depth (ft.)
Anhydrite	1,210
Yates	2,238
Queen	2,780
Grayburg	3,106
Pay	3,222

NOELKE FIELD
Crockett County, Texas

Pay zone	Samma sand
TD (avg.)	1,471 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$250.00

Normal Rig-Time Distribution

Per cent on footage rate	91.5
Per cent on day-work rate	8.5
Total days (spud to rig release)	17½
Total number of bits	Cable tool

Equipment

Fuel: Furnished.
Water supply: Furnished.
Nearest supply center: 80 miles.
Terrain and roads: Rough and fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7	608	
Oil string	5½ and 4½	1,470	165
Tubing	2⅜	1,451	

Average Formation Tops

Formation—	Drilling depth (ft.)
Samma sand	1,440

PENWELL FIELD
Ector County, Texas

Pay zone	San Andres
TD (avg.)	3,565 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.25
Day-work rate with drill pipe	$550.00
Day-work rate without drill pipe	$450.00

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	10-12
Total number of bits	8-10

Equipment

Fuel: Butane.
Nearest supply center: Odessa.
Terrain and roads: Sandy, caliche.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	750	500
Oil string	5½	3,450	500

GOLDSMITH FIELD
Ector County, Texas

Pay zone	Clearfork
TD (avg.)	5,850-6,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.45-$5.00
Day-work rate with drill pipe	$650.00-$750.00
Day-work rate without drill pipe	$600.00-$650.00

Normal Rig-Time Distribution

Per cent on footage rate	87
Per cent on day-work rate	13
Total days (spud to rig release)	20-30
Total number of bits	22-25

Equipment

Fuel: Natural gas.
Water supply: Lease wells.
Nearest supply center: Odessa, Tex.
Terrain and roads: Flat; gravel roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	1,500	500
Oil string	5½	5,850	350

Typical Mud Program

Material—	Amount
Zeogel, sacks	58
Impermix, sacks	42
Fibertex, sacks	89

Average Formation Tops

Formation—	Drilling depth (ft.)
Anhydrite	1,500
Yates	2,800
San Andres	4,100
Clearfork	5,500
Tubb	6,000

Remarks: Usual mud bill: $2,000-$3,000.

ESKOTA (NOODLE CREEK) FIELD
Fisher County, Texas

Pay zone	Noodle Creek
TD (avg.)	2,630 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.60
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	82
Per cent on day-work rate	18
Total days (spud to rig release)	10
Total number of bits	5

Equipment

Fuel: Butane.
Water supply: Surface lake.
Nearest supply center: Abilene.
Terrain and roads: Rolling hills; black-top road through field.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	190	135
Oil string	5½	2,630	50

Typical Mud Program

Material—	Amount
Magcogel, lb.	15,500
Soda ash, lb.	4,000
Caustic soda, lb.	800
Quebracho, lb.	700

Average Formation Tops

Formation—	Drilling depth (ft.)
B. Coleman Junction	2,240
Noodle Creek lime	2,580
Canyon Reef lime	4,420

HOMAN FIELD
Gaines County, Texas

Pay zone	Yates sand
TD (avg.)	3,550 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Total days (spud to rig release)	12
Total number of bits	5-7

Equipment

Fuel: Natural gas.
Water supply: Water wells.
Nearest supply center: Hobbs, N. M., 40 miles.
Terrain and roads: Terrain flat; roads excellent.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	±350	250
Oil string	5½	±3,250	250

Remarks: Open hole completion.

Typical Mud Program

Material—	Amount
Brine, bbl.	1,200
Salt gel, sacks	100

Average Formation Tops

Formation—	Drilling depth (ft.)
Rustler anhydrite	2,300
Yates sand	3,400

GARZA (GLORIETA) FIELD
Garza County, Texas

Pay zone	Glorieta dolomite
TD (avg.)	3,900 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$528.00
Day-work rate without drill pipe	$480.00

Normal Rig-Time Distribution

Per cent on footage rate	65
Per cent on day-work rate	35
Total days (spud to rig release)	8
Total number of bits	6-7

Equipment

Fuel: Butane.
Water supply: Trucking.
Nearest supply center: Post.
Terrain and roads: Paved highway and dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	100	100
Oil string	5½	TD	350 to 400

Remarks: Oil string set through pay section.

Typical Mud Program

Material—	Amount
Salt gel, lb.	4,960
My-Lo-Je, lb.	2,300
Crude oil or diesel, bbl.	50

Average Formation Tops

Formation—	Drilling depth (ft.)
Top anhydrite	1,030
Top Yates	1,460
Top San Andres dolomite	2,550
Top Glorieta	3,720

Remarks: The basal San Andres has a tendency to stick bits. A mud with a water loss below 10 cc. with crude oil or diesel overcomes this.

HOWARD-GLASSCOCK FIELD
Howard County, Texas

Pay zone	San Andres
TD (avg.)	2,600 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.80
Day-work rate with drill pipe	$504.00
Day-work rate without drill pipe	$480.00

Normal Rig-Time Distribution

Per cent on footage rate	75
Per cent on day-work rate	25
Total days (spud to rig release)	13
Total number of bits	8

Equipment

Fuel: Butane.
Water supply: Company wells.
Nearest supply center: Big spring.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	330	175
Oil string	5½	2,600	280

Typical Mud Program

Material—	Amount
Aquagel, sacks	40
Lime, sacks	2
Cottonseed hulls, sacks	10
Fibertex, sacks	10
Impermix, sacks	30
Impermix, sacks	6

Average Formation Tops

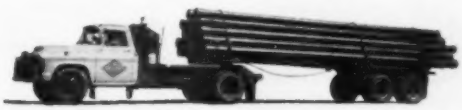
Formation—	Drilling depth (ft.)
Yates sand	1,300
Chalk sand	1,650
Grayburg	1,900
San Andres	2,200

HOWARD-GLASSCOCK FIELD
Howard County, Texas

Pay zone	San Angelo
TD (avg.)	2,894 ft.

Congrats and $25 to Joe W. Lockhart, Colorado-Wyoming Gas Co., 421 Continental Oil Bldg., Denver, Colorado, for this quip.

Authorities have estimated that oil men must discover over 70 billion barrels of new oil in the next 20 years. This will call for a lot of Lone Star API pipe . . . and Lone Star is expanding its huge, ultra modern plant with a new open hearth furnace and a new stretch-reducing mill. Joe Roughneck, heart of the oil industry, can depend on Lone Star.



Neighbor, wherever you are, specify Lone Star and we both get a good deal.

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Mudwonder valves on Gulf offshore rig. Mudwonder was selected here for low maintenance cost.

Why Mudwonders* outwork, outlast other mud valves

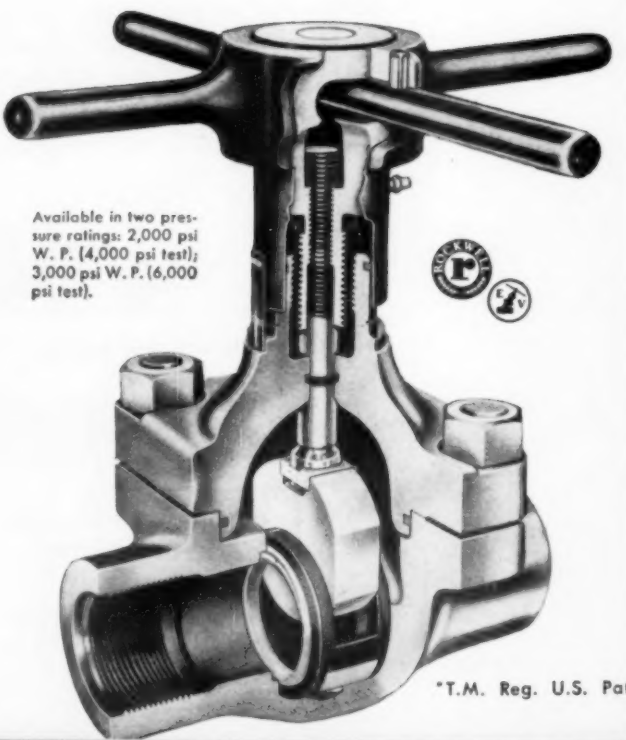
by Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

How, in the space of two-and-a-half years, can a newly-introduced mudline valve become the favorite of thousands of oil well drilling rig operators throughout the country? This question looms large in the minds of those who see Rockwell-built Edward Mudwonder valves on drilling rigs all over the United States and Canada . . . and as far afield as South America and the Middle East too. The reason Mudwonder is stocked by virtually every oil field supply store—the reason most of the new Gulf offshore rigs are equipped with Mudwonder—is comparatively simple.

Easier to install, easier to maintain

Specially selected materials give Mudwonder parts an exceptionally long, trouble-free service life. Resilient buna-N inserts are molded integrally over steel wear rings and a hard-chromed steel gate. The stainless steel stem is a separate element, keyed into the gate to effect a sliding union which accommodates normal movement without danger of binding, even under rugged use. Any of these elements can be simply and quickly replaced, if necessary, without disturbing the piping hook-up. *Only one wrench is necessary.*



Available in two pressure ratings: 2,000 psi W. P. (4,000 psi test); 3,000 psi W. P. (6,000 psi test).

*T.M. Reg. U.S. Pat.

Parts inventory simplified

Extra seats—and perhaps a spare gate in each size—are all the parts needed to keep Mudwonders in top shape. Seats and gates are interchangeable among pressure classes. Whenever maintenance becomes necessary, the procedure is simplicity itself: entire bonnet assembly unbolts and lifts off without disturbing the mudline hookup—and the working parts are exposed for inspection. Parts replacement can be made with practically no downtime.

No "sanding up"

Sand simply does not collect in the Mudwonder. Large, unrestricted openings into bonnet cavity permit a flow of mud to keep bonnet flushed out. Erosive wear from the mud is confined to the buna-N seat insert and the hard chromed gate. Resilience of buna-N permits use of steel wear rings to cut off the high-velocity flow of mud and absorb the abrasion, while the buna-N itself makes the seal.

Quick, positive shut-off

Gate is moved by a double-thread yoke bushing, which engages stem and bonnet threads simultaneously . . . gives 2-to-1 ratio for fast opening and closing. Dual action sealing allows line pressure to help make drop-tight shut-offs . . . prevents leaking or draining through valve when line pressure is removed. High closing loads are not necessary to make a tight seal. The Mudwonder sealing principle is such that the valve will hold rated pressure when the gate contacts the buna-N sealing surfaces. "Bumping" a Mudwonder closed—or using a "cheater"—is never necessary.

Protected bonnet threads

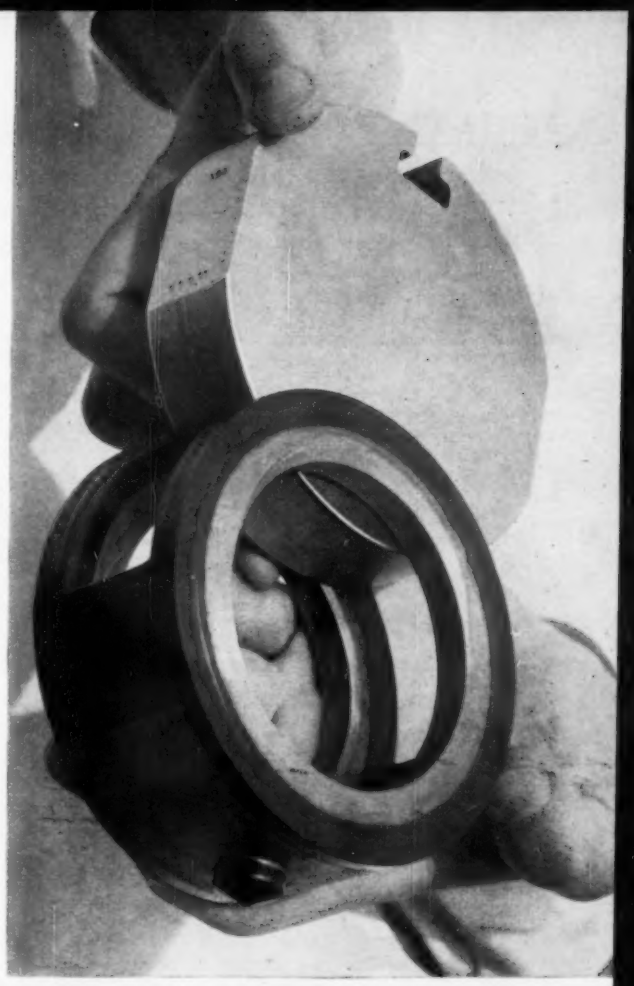
Stem, yoke bushing and bonnet threads are completely lubricated before leaving the factory, and are sealed against dirt, dust and weather. The inner stem seal is provided by a buna-N ring and leather back-up washer. A rigid shield and high-strength felt ring form the outer bonnet seal. A special relief vent in Mudwonder serves a three-fold purpose: (1) If valve is over-lubricated, excess grease escapes through the vent; (2) Mud escaping through the vent is the signal for replacement of worn or damaged "O" ring seal or back-up washer; (3) Because the vent equalizes air pressure in yoke bushing chamber as valve is opened or closed, you get easier operation.

Low operating torque

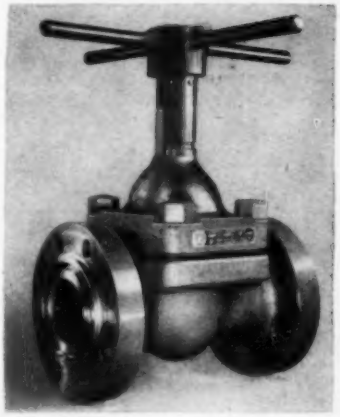
The hard-chromed alloy steel gate and the stainless stem are separate elements, slot-connected; this eliminates stem bending and binding due to line pressure on the gate. Low pitch threads reduce turning friction. The Impactor® built into the Mudwonder handwheel provides *twice* the torque of conventional handwheels . . . particularly valuable in opening the valve against extreme differential pressure. Hard chrome on the gate produces a smooth, low-friction sliding surface against the seat.

Easily available—competitively priced

Drilling men have tried Mudwonder—even abused it—to prove its economical superiority in operation, installation and maintenance . . . and this is why drillers all over the world say "Make mine Mudwonder!" Ask your favorite oil field supply store for complete information . . . or write, wire or call Edward Valves, Inc., East Chicago, Indiana.

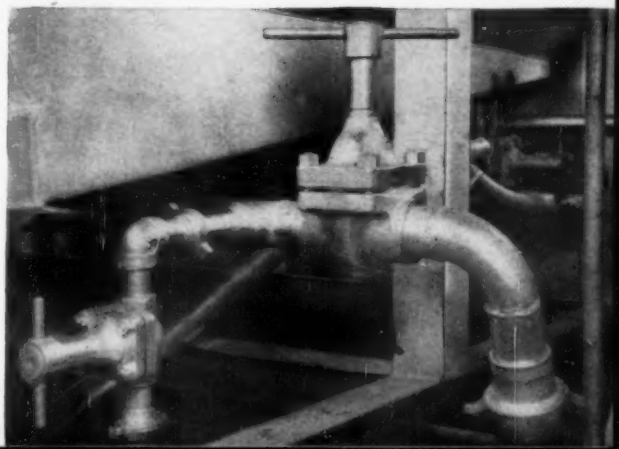


The "stout heart" of the Mudwonder absorbs wear and abrasion.



Mudwonder also available with flanged ends; illustrated is Fig. 3118, 3,000 psi W. P. (6,000 psi test).

Because valves are easy to operate and parts can be replaced without disturbing line, Mudwonder can be installed in any position.



Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	81
Per cent on day-work rate	19
Total days (spud to rig release)	16
Total number of bits	12

Equipment

Fuel: Butane.
Water supply: Water well.
Nearest supply center: Big Spring.
Terrain and roads: Very hilly.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	164	100
Oil string	5½	2,893	50

Typical Mud Program

Material—	Amount
Aquagel, sacks	81
Lime, sacks	3
Lost-circulation material, sacks	5
Starch, sacks	136
Zeogel, sacks	90

Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	1,985
San Angelo	2,800

BOOMERANG (PENNSYLVANIAN) FIELD
Kent County, Texas

Pay zone — Strawn reef
TD (avg.) — 6,570 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.00
Day-work rate with drill pipe	$750.00
Day-work rate without drill pipe	$700.00

Normal Rig-Time Distribution

Per cent on footage rate	87
Per cent on day-work rate	13
Total days (spud to rig release)	40
Total number of bits	36

Equipment

Fuel: Diesel oil.
Nearest supply center: Post, Tex.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	1,200	750
Oil string	5½	6,595	125

Typical Mud Program

Material—	Amount
Gel, sacks	1,281
Hulls, cedar seal and clay, sacks	235
Caustic, sacks	28
Soda ash, sacks	50
Ray flow, sacks	31

Use water to 3,100 ft.

Average Formation Tops

Formation—	Drilling depth (ft.)
Noodle Creek	4,110
Saddle Creek	4,290
Canyon lime	6,425
Strawn reef	6,571

LEE HARRISON FIELD
Lubbock County, Texas

Pay zone — Clearfork
TD (avg.) — 4,950 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$500.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	21

Equipment

Fuel: Natural gas.
Water supply: Irrigation wells.
Nearest supply center: Levelland.
Terrain and roads: Flat cultivated farm land.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	450	300
Oil string	5½	4,900	150

Remarks: Clear water to top of Clearfork. Set pipe on top of pay. Drill in with cable tools.

DORA ROBERTS (ELLENBURGER) FIELD
Midland County, Texas

Pay zone — Ellenburger (5 to 7 other zones productive)
TD (avg.) — 13,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$9.00
Day-work rate with drill pipe	$1,100.00
Day-work rate without drill pipe	$1,000.00

Normal Rig-Time Distribution

Per cent on footage rate	60
Per cent on day-work rate	40
Total days (spud to rig release)	84
Total number of bits	90

Equipment

Fuel: Natural gas.
Water supply: Wells.
Nearest supply center: Odessa.
Terrain and roads: Level; caliche.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	225	275
Intermediate	8⅝	6,000	3,000 (2-stage)
Oil string	5½	13,000	900

Typical Mud Program

Material—	Amount
Gel, sacks	745
Barytes, sacks	50
Salt gel, sacks	450
Starch, sacks	40
Quebracho, sacks	40
Salt, sacks	1,200
Driscose, sacks	600

Plus caustic soda, soda ash, bicarb. soda and lost-circulation materials.

Average Formation Tops

Formation—	Drilling depth (ft.)
Spraberry	7,900
Strawn	9,750
Pema. Bend	10,100
Devonian	12,300
Ellenburger	12,900

HOWARD-GLASSCOCK FIELD
Mitchell County, Texas

Pay zone — Yates
TD (avg.) — 1,250 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.25
Day-work rate with drill pipe, per hour	$22.00
Day-work rate without drill pipe, per hour	$20.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	4
Total number of bits	3

Equipment

Fuel: Butane.
Water supply: Hauled.
Nearest supply center: Big Spring.
Terrain and roads: Moderately rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	135	75
Oil string	4½ and 5½	1,250	100

Typical Mud Program

Material—	Amount
Aquagel, sacks	40
Impermix, sacks	15
Impermix, pres., sacks	2

Average Formation Tops

Formation—	Drilling depth (ft.)
Yates sand	1,200-1,250

ROARING SPRINGS FIELD
Motley County, Texas

Pay zone — Penn. reef
TD (avg.) — 4,200 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.00
Day-work rate with drill pipe	$650.00-$735.00
Day-work rate without drill pipe	$600.00-$675.00

Normal Rig-Time Distribution

Per cent on footage rate	74.1
Per cent on day-work rate	26
Total days (spud to rig release)	15
Total number of bits	12

Equipment

Fuel: Contractor.
Water supply: Contractor.
Nearest supply center: Sweetwater or La Mesa.
Terrain and roads: Flat; good, sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	219	150
Oil string	5½	4,140	125

Typical Mud Program

Material—	Amount
Gel, sacks	537
Chemical, lb.	690
Lost-circulation material, sacks	24

Pipe of Tenite Butyrate cuts downtime

This pipe resists paraffin plugging

The problem of paraffin plugging is often completely eliminated with pipe made of Tenite Butyrate. The clean, smooth inner wall of this plastic pipe offers no toe-holds where paraffin can start accumulating. These smooth walls also provide up to 40% greater flow volume than does metal pipe for the same head loss. Result: less load on pumps.

Pipe made of Tenite Butyrate offers many other advantages, too. It resists corrosion caused by sour crudes, salt water and alkali soils. It is extremely light in weight. One 20-foot length of 4" pipe made of Tenite Butyrate plastic weighs only 20 pounds—about one-sixth the weight of metal pipe of the same length and diameter. It is easily cut with a hand saw and joined quickly with only slip-sleeve couplings and solvent cement. Using this method, three unskilled men can lay 4,000 feet of 4" pipe in only one working day.

With Tenite Butyrate, you get a pipe line that is easily installed, that performs efficiently, and requires virtually no maintenance. You also get the substantial savings that accompany each of these advantages.

Write us for more information, as well as the names of companies that produce pipe and a complete range of fittings made of Tenite Butyrate. Address: EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

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1932—EASTMAN'S 25TH YEAR IN PLASTICS—1957

A 16-mm. sound-color film, "PLASTIC PIPELINES," is available upon request.

Average Formation Tops

Formation—	Drilling depth (ft.)
Tubb	2,222
Wichita Albany	2,660
Wolfcamp	3,255
Cisco	4,048
Permo-Penn.	4,150

REGULAR FIELD
Palo Pinto County, Texas

Pay zone	Strawn sand
TD (avg.)	1,285 ft.

Cost Averages, Per Ft. or Day

Footage price (cable tool)	$3.25

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	14

Equipment

Fuel: Butane.
Water supply: Lease.
Nearest supply center: Mineral Wells.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8	60	5
Oil string	5½	1,250	20

Average Formation Tops

Formation—	Drilling depth (ft.)
Palo Pinto lime	185
Strawn sand	1,235-1,290

FORD (DELAWARE SAND) FIELD
Reeves County, Texas

Pay zone	Delaware sand
TD (avg.)	2,675 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.25

Normal Rig-Time Distribution

Total days (spud to rig release): cable tools	30

Equipment

Fuel: Butane.
Water supply: Pecos River.
Nearest supply center: Monahans and Kermit.
Terrain and roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	200
Oil string	5½	2,675	700

Average Formation Tops

Formation—	Drilling depth (ft.)
Anhydrite	900
Delaware sand	2,660

REVILO-GLORIETA FIELD
Scurry County, Texas

Pay zone	Glorieta
TD (avg.)	2,700 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$550.00
Day-work rate without drill pipe	$500.00

Normal Rig-Time Distribution

Per cent on footage rate	98
Per cent on day-work rate	2
Total days (spud to rig release)	5
Total number of bits	8

Equipment

Fuel: Butane.
Water supply: Truck.
Nearest supply center: Snyder.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	150	130
Oil string	4½ o.d. or 5½ o.d.	approx. 2,600	150 or 200

Typical Mud Program

Material—	Amount
Salt gel, sacks	25 to 35
Starch, sacks	15 to 25

Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	1,800
Glorieta	2,550

REGULAR FIELD
Shackelford County, Texas

Pay zone	Bluff Creek
TD (avg.)	1,700 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.25
Day-work rate without drill pipe, per hour	$20.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	5
Total number of bits	4

Equipment

Fuel: Butane.
Water supply: Tanks.
Nearest supply center: Abilene.
Terrain and roads: Easily accessible.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7	60	75
Oil string	4½	1,700	75

Typical Mud Program

Material—	Amount
Gel, sacks	80
Quebracho, sacks	20
Soda ash, sacks	10
Caustic, sacks	4

Average Formation Tops

Formation—	Drilling depth (ft.)
Tannehill	1,470
Saddle Creek	1,600
Bluff Creek	1,630

SHIPLEY-QUEEN FIELD
Ward County, Texas

Pay sand	Queen sand
TD (avg.)	2,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day-work rate	15
Total days (spud to rig release)	13
Total number of bits	7

Equipment

Fuel: Butane.
Water supply: Irrigation canal.
Nearest supply center: Monahans.
Terrain and roads: Pavement adjacent to lease.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	130	120
Oil string	5½	2,500	150

Remarks: Occasional lost-circulation 0 to 150 ft. and around 1,000 ft.

Average Formation Tops

Formation—	Drilling depth (ft.)
Queen sand	2,400

Remarks: Possible production in lime and sand stringers from 2,200 ft. to TD. Perforation interval for completion is difficult to select as electric logs do not correlate with gamma-ray neutron logs. The Queen sand contains a radioactive material which distorts the curve.

KERMIT (ELLENBURGER) FIELD
Winkler County, Texas

Pay zone	Ellenburger (oil) and Devonian or Fusselman (gas) (dual completions).
TD (avg.)	10,645 ft.

Cost Averages, Per Ft. or Day

Footage price	$10.90
Day-work rate with drill pipe	$1,035.00
Day-work rate without drill pipe	$900.00

Normal Rig-Time Distribution

Per cent on footage rate	57.3
Per cent on day-work rate	42.7
Total days (spud to rig release)	138
Total number of bits	111

Equipment

Fuel: Natural gas.
Water supply: Shallow water wells.
Nearest supply center: Kermit, Tex.
Terrain and roads: Sandy, caliche roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	1,000	700
Intermediate	9⅝	4,000	1,900
Oil string	7	TD	900

Average Formation Tops

Formation—	Drilling depth (ft.)
Yates	2,450
Devonian	8,100
Fusselman	8,600
Ellenburger	10,430

BRAHANEY FIELD
Yoakum County, Texas

Pay zone	San Andres
TD (avg.)	5,350 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$528.00

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Wherever you are drilling . . . on land or offshore . . . whether you are spooling wire line in drawworks, loading cranes or deck hoists . . . you know the importance of efficient spooling. Excessive wear, tangled and broken line can cause hours of costly lost time, and idle equipment.

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Patent Nos. Counterbalance Nos. 2,734,695, 2,732,150. Controlled Parallel and Helical Spooling, Nos. 2,708,080, 2,620,996. Application of grooving, Nos. 2,599,926, 2,204,938. Removable End Fillers, No. 2,216,819. Other patents pending.

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Dowell paraffin solvents are MORE EFFECTIVE!

Using samples of the paraffin from your well, Dowell engineers can show you with their portable solvent-testing kit how much more effective Dowell's Paraffin Solvents are. The kit also shows which Dowell solvent is the right one to use for maximum paraffin-removal.

The success of paraffin-removal treatments depends as much on the study of the problem and method of treatment as on the solvent chosen. Dowell recommends a careful study of the well, line or tank in order to determine the amount, condition and character of the paraffin deposit.

To complete the picture, each solvent offered by Dowell will effectively solve the problem for which it is designed. Each has exceptional dissolving properties, allowing it to penetrate even the toughest paraffin.

Various methods of applying Dowell Paraffin Solvents are described in a handy booklet, "Proven Methods For The Chemical Removal of Paraffin Deposits." It is available from any Dowell engineer.

When paraffin becomes your problem, call Dowell. Dowell Paraffin Solvents are available at many oil field supply stores and the 165 Dowell offices and stations in the U. S. and Canada. In Venezuela contact United Oilwell Service. Or write Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Normal Rig-Time Distribution

Per cent on footage rate	85
Per ceent on day-work rate	15
Total days (spud to rig release)	25
Total number of bits	18

Equipment

Fuel: Butane.
Water supply: Trucks.
Nearest supply center: Plains, Tex., 10 miles.
Terrain and roads: Level, caliche.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	400	275
Oil string	5½	5,350	100

Typical Mud Program

Material—	Amount
Salt gel, sacks	330
Starch, sacks	110
Preservative, sacks	20

PRENTICE (6,700-FT.) FIELD
Yoakum County, Texas

Pay zone — Upper Clearfork dolomite
TD (avg.) — 6,750 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.75
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$775.00

Equipment

Fuel: Natural gas.
Water supply: Water wells.
Nearest supply center: Brownfield, Tex.
Terrain and roads: Terrain flat; roads excellent.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	None		
Intermediate	8⅝ or 9⅝	2,500	1,000
Oil string	5½ or 7	6,500 or 6,750	600

Typical Mud Program

Material—	Amount
Salt, sacks	1,000
Salt gel, sacks	200
Starch, sacks	100
Diesel oil, bbl.	150

Average Formation Tops

Formation—	Drilling depth (ft.)
Rustler anhydrites	2,500
Yates sand	3,300
Salt	3,600
San Andres	4,600
Glorieta	5,900

SLAUGHTER FIELD
Cochran County, Texas

Pay zone — San Andres lime
TD (avg.) — 5,100 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$500.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	14
Total number of bits	15

Equipment

Fuel: Butane.
Water supply: Water wells.
Nearest supply center: Levelland, Tex.
Terrain and roads: Sandy.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	300	250
Oil string	5½	5,035	250

Average Formation Tops

Formation—	Drilling depth (ft.)
Anhydrite	2,360
Brown lime	3,940
San Andres	4,335
Top of pay	5,035-50

Remarks: Operators use native mud with 70 bbl. lease crude.

SPRABERRY (CLEARFORK) (7,250-FT.) FIELD
Upton County, Texas

Pay zone — Clearfork
TD (avg.) — 7,250 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75-$4.00
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$600.00

Normal Rig-Time Distribution

Per cent on footage rate	90-95
Per cent on day-work rate	5-10
Total days (spud to rig release)	16-23
Total number of bits	25

Equipment

Fuel: Natural gas.
Water supply: Water wells.
Nearest supply center: 20 miles away.
Terrain and roads: Level, good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	250	200
Oil string	4½-5½	7,256	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Clearfork	7,200

SPRABERRY TREND
Midland County, Texas

Pay zone — Spraberry
TD (avg.) — 7,600 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.25
Day-work rate with drill pipe	$750.00
Day-work rate without drill pipe	$650.00

Normal Rig-Time Distribution

Per cent on footage rate	97
Per cent on day-work rate	3
Total days (spud to rig release)	25
Total number of bits	33

Equipment

Fuel: Natural gas.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	350	150
Oil string	5½	7,800	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Top of Spraberry	7,200

ARTHUR (SPRABERRY) FIELD
Borden County, Texas

Pay zone — Spraberry
TD (avg.) — 8,009 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$678.00
Day-work rate without drill pipe	$628.00

Normal Rig-Time Distribution

Per cent on footage rate	84
Per cent on day-work rate	16
Total days (spud to rig release)	31
Total number of bits	50

Equipment

Fuel: Butane.
Water supply: Company wells.
Nearest supply center: Big Spring.
Terrain and roads: Fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	350	330
Intermediate	7⅝	3,300	1,100
Oil string	5½	7,600	250

Typical Mud Program

Material—	Amount
Aquagel, sacks	220
Hi-Vis Driscose, sacks	28
Lime, sacks	3
Mud fiber, sacks	250
Leather Floc, sacks	50
Carbonox, sacks	7
Carbon black oil, gal.	6,200

Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	3,210
Spraberry	6,380
Lower Spraberry	6,910
Dean	7,790

TXL (TUBB) FIELD
Ector County, Texas

Pay zone — Goldsmith (Clearfork) at 5,300 ft. and Tubb at 6,000 ft.
TD (avg.) — 6,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50-$5.00
Day-work rate with drill pipe	$775.00
Day-work rate without drill pipe	$700.00

Normal Rig-Time Distribution

Per cent on footage rate	70
Per cent on day-work rate	30
Total days (spud to rig release)	33

Equipment

Fuel: Butane.
Water supply: Contractor.
Nearest supply center: Odessa.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	1,600	620
Oil string	5½	6,200	650

Typical Mud Program

Material—	Amount
Gel, sacks	300

Starch, sacks	160
Caustic soda, sacks	10
Soda ash, sacks	15
Salt, sacks	980

Average Formation Tops

Formation—	Drilling depth (ft.)
Clearfork	5,318
Tubb	6,017

UNIVERSITY BLOCK 9 (DEVONIAN) FIELD
Andrews County, Texas

Pay zone	Devonian
TD (avg.)	10,700 ft.

Cost Averages, Per Ft. or Day

Footage price	$8.50
Day-work rate with drill pipe	*$950.00
Day-work rate without drill pipe	$950.00

*Plus drill pipe rental.

Normal Rig-Time Distribution

Per cent on footage rate	96.4
Per cent on day-work rate	2.8
Total days (spud to rig release)	92.0
Total number of bits	89.0

Equipment

Fuel: Lease gas.
Water supply: Lease water well.
Nearest supply center: Andrews, Tex.
Terrain and roads: Sandy, caliche, roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	11¾	401	375
Intermediate	8⅝	4,550	2,450
Oil string	5½	10,570	1,700

Typical Mud Program

Material—	Amount
Caustic soda, lb.	2,800
Quebracho, lb.	3,100
Soda ash, lb.	2,500
Lime, lb.	500
Carbonex, lb.	1,000
Smentox, lb.	500
Diesel, gal.	8,810
Lost circulation, lb.	2,750
Starch, lb.	1,250
Bentonite, lb.	96,700

Average Formation Tops

Formation—	Drilling depth (ft.)
Wolfcamp	8,400
Strawn	9,000
Devonian	10,550

WATTS (GARDNER) FIELD
Nolan County, Texas

Pay zone	Gardner sand
TD (avg.)	5,450 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe, per hour	$25.00
Day-work rate without drill pipe, per hour	$22.50

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	24
Total number of bits	16

Equipment

Fuel: Butane.
Water supply: Local ponds.
Nearest supply center: Winters, Tex.
Terrain and roads: Moderately rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	500	400
Oil string	5½	5,500	150

Typical Mud Program

Material—	Amount
Aquagel, sacks	500
Soda ash, sacks	70
Hulls—other lost-circulation material, sacks	30
Caustic, sacks	5
Lime, sacks	5

Average Formation Tops

Formation—	Drilling depth (ft.)
Canyon reef	4,300
Palo Pinto	4,700
Gains lime	5,175
Gardner lime	5,400
Gardner sand	5,450

WELCH FIELD
Dawson County, Texas

TD (avg.)	4,925 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	95 to 100
Per cent on day-work rate	0 to 5
Total days (spud to rig release)	13
Total number of bits	12 to 13

Equipment

Fuel: Butane.
Water supply: Local.
Nearest supply center: Local.
Terrain and roads: Sandy, good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	300	150
Intermediate	8⅝	1,800	150
Oil string	5½	4,925	300

Remarks: Operators use a natural mud unless the pay zone is cored.

KING (DEVONIAN) FIELD
Eddy County, New Mexico

Pay zone	Devonian
TD (avg.)	12,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$10.50
Day-work rate with drill pipe	$1,075.00
Day-work rate without drill pipe	$975.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	101

Equipment

Fuel: Diesel.
Water supply: Water wells.
Nearest supply center: Lovington, N. M.
Terrain and roads: Smooth pasture land.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	360	350
Intermediate	8⅝	4,600	1,800 Pozmix, 100 neat
Oil string	5½	12,667	750

Average Formation Tops

Formation—	Drilling depth (ft.)
Anhydrite	2,200
Yates	3,100
Mississippian	11,500
Devonian	12,300

WARREN (McKEE) FIELD
Lea County, New Mexico

Pay zone	McKee sand (9,063-9,139 ft.)
TD (avg.)	9,232 ft.

Cost Averages, Per Ft. or Day

Footage price	$6.00
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$750.00

Normal Rig-Time Distribution

Per cent on footage rate	74
Per cent on day-work rate	26
Total days (spud to rig release)	59
Total number of bits	65

Equipment

Fuel: Lease gas.
Water supply: Water wells in area.
Nearest supply center: Hobbs, N. M. (12 miles).
Terrain and roads: Sandy; rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	229	250
Intermediate	7⅝	3,999	2,000
Oil string	5½	9,022	515

Typical Mud Program

Material—	Amount
Magcobar, lb.	3,000
Magcogel, lb.	39,500
Lime, lb.	150
Soda ash, lb.	5,600
Caustic soda, lb.	1,700
Quebracho, lb.	1,900
Salt gel, lb.	4,800
My-Lo-Jel, lb.	450
Fiberseal, lb.	34
Magcofiber, sacks	23
Driscose, lb.	800
Leather, lb.	1,900
Cell-O-Seal, lb.	350
Cypan, lb.	450

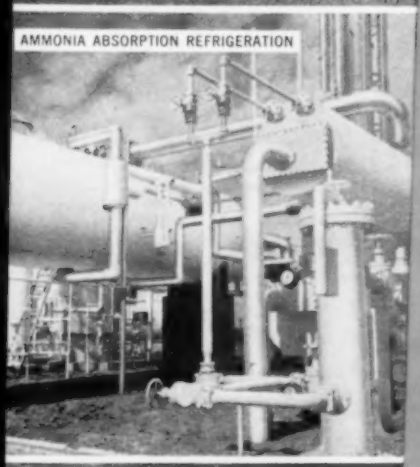
Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	4,030
Glorieta	5,315
Blinebry	5,865
Tubb	6,372
Drinkard	6,680
Abo	6,967
Devonian	7,786
Montoya	8,447
Simpson sand	8,761
McKee pay	9,063

NORTH GLADIOLA FIELD
Lea County, New Mexico

Pay zone	Devonian
TD (avg.)	12,000 ft.

BS&B RESEARCH SHOWS THE WAY



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Beginning with the manufacture of wooden tanks for gauging and storage back in 1893, BS&B for 64 years has served the equipment needs of oilfield production men wherever crude oil was being produced.

As changing times have called for better and more *specialized* equipment to do a more comprehensive field production job, BS&B has taken the lead in the development of new and better equipment to meet these requirements.

Two recent examples are the introduction of BS&B *"Phanto-Matic" Lease Systems* which provide full lease automation from the wellhead to the pipeline, and the BS&B *Ammonia Absorption Refrigeration System* which utilizes power from natural gas on the lease to produce refrigeration temperatures below 0° F. Both were developed at BS&B's modern research and development laboratory facilities, unique in the industry.

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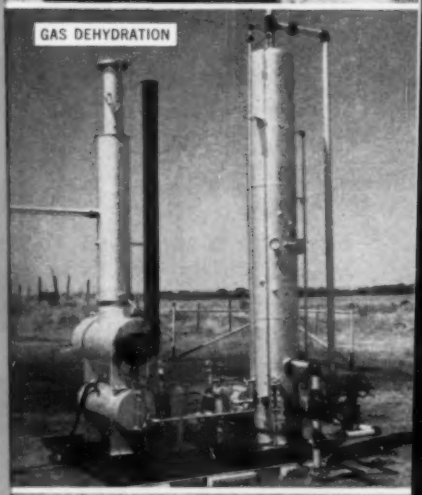

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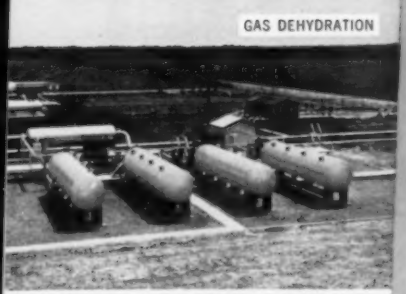
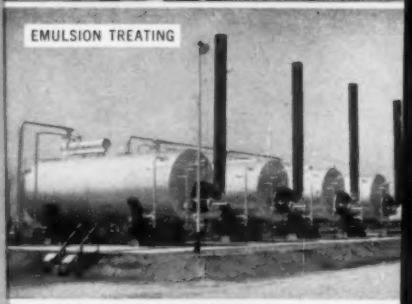




OVER 60 YEARS — BS&B — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

Oilfield Equipment Division, Dept. 1-A10
P. O. Box 1714 Oklahoma City, Okla.

Cost Averages, Per Ft. or Day

Footage price	$8.80
Day-work rate with drill pipe	(*)
Day-work rate without drill pipe	(†)

*0-10,000 ft., $950.00; 10,000-12,500 ft., $1,000.00. †0-10,000 ft., $875.00; 10,000-12,500 ft., $900.00.

Normal Rig-Time Distribution

Per cent on footage rate	92
Per cent on day-work rate	8
Total days (spud to rig release)	83
Total number of bits	78

Equipment

Fuel: Furnished by contractor.
Water supply: Furnished by contractor.
Nearest supply center: Lovington, N. M.
Terrain and roads: Rolling, roads good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	307	400
Intermediate	9⅝	4,536	2,500
Oil string	7	12,021	200

Typical Mud Program

Material—	Amount
Gel, tons	38.1
Chemical, lb.	39,525
Lost-circulation material, lb.	500
Salt, tons	3.25

Average Formation Tops

Formation—	Drilling depth (ft.)
San Andres	4,440
Tubb	7,125
Wolfcamp	9,050
Mississippian	11,300
Devonian	11,980

SOUTH HIGH LONESOME FIELD
Eddy County, New Mexico

Pay zone: Grayburg (Premier sand)
TD (avg.): 2,400 ft.

Cost Averages, Per Ft. or Day

Footage price (cable tools)	$3.25
Day-work rate	$250.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	30

Equipment

Fuel: Butane.
Water supply: Truck.
Nearest supply center: Artesia.
Terrain and roads: Rolling with dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	240	100
Oil string	5½	2,350	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Queen	1,600-1,625
Premier	2,350-2,380
San Andres	2,375-2,400

Remarks: Wells are fractured with 10,000 to 20,000 gal. and 1½ lb. of sand per gal. Wells potential about 100 bbl. per day after fracture treatment.

DANBURY SALT DOME FIELD
Brazoria County, Texas

Pay zone: Miocene sands
TD (avg.): 4,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.75
Day-work rate with drill pipe	$600.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	10
Total number of bits	5

Equipment

Fuel: Lease and gas.
Water supply: Lease.
Nearest supply center: Houston.
Terrain and roads: Excellent.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	300	150
Oil string	5½	3,500 to 4,000	300

Typical Mud Program

Material—	Amount
Gel, sacks	1,000

Remarks: All Miocene sands down to ±4,700 ft. Best production at 2,700 and 3,450 ft. Frio production from 5,600-5,700 ft. Frio deeper on flanks. Casing and mud programs altered on Frio wells. 1,200 ft. of 10¾-in. or 13⅜-in. surf.; 5½-in. to TD.

FASHING EDWARDS FIELD
Atascosa County, Texas

Pay zone: Edwards limestone
TD (avg.): 11,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$925.00
Day-work rate without drill pipe	$875.00

Normal Rig-Time Distribution

Per cent on footage rate	53
Per cent on day-work rate	47
Total days (spud to rig release)	76
Total number of bits	34

Equipment

Fuel: Butane.
Water supply: Water wells and surface ponds.
Nearest supply center: Pleasanton.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,645	850
Oil string	5½	10,920	450

Typical Mud Program

Material—	Amount
Regular mud, tons	139
Oil base mud, bbl.	556
Chemicals, sacks	419
Lost circulation material, sacks	18

HIGH ISLAND FIELD
Galveston County, Texas

Pay zone: Miocene (6 pays); Pliocene (1 pay)
TD (avg.): Miocene, 6,000 ft.; Pliocene, 3,800 ft.

Cost Averages, Per Ft. or Day

Footage price	Straight day work
Day-work rate with drill pipe	$800.00
Day-work rate without drill pipe	$750.00

Normal Rig-Time Distribution

Per cent on day-work rate	100
Total days (spud to rig release	Mio. (30), Plio. (20)
Total number of bits	Mio. (10-20), Plio. (13)

Equipment

Fuel: Gas.
Water supply: Irrigation canal.
Nearest supply center: Beaumont (45 miles).
Terrain and roads: Flat—good roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	80	100
Intermediate	10¾	750	300
Oil string	7	Total depth	500

Typical Mud Program

	Amount— Miocene wells	Pliocene wells
Barites, sacks	800	400
Gel, sacks	150	100
Kembreak, lb.	400	250
Phosphates, lb.	1,500	1,000
Caustic, lb.	750	500
Soda ash, lb.	2,000	1,500
Clay, sacks	120	80

Average Formation Tops

Formation—	Drilling depth (ft.)
Pliocene	1,700
Miocene	4,500

HULL FIELD
Liberty County, Texas

Pay zone: Yequa-Cook Mountain
TD (avg.): 4,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$3

Equipment

Fuel: Butane-natural gas.
Water supply: Field.
Nearest supply center: Field.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	1,100-1,400	Cement to surface
Oil string	5½	4,500	200 (to surface)

Average Formation Tops

Formation—	Drilling depth (ft.)
Vicksburg	2,000-3,000
Cook Mountain	3,000-5,000

JABONCILLOS CREEK FIELD
Duval County, Texas

Pay zone: Frio sands (New Year 3,050 ft., approx.; Ramon sand 3,100 ft. approx.)
TD (avg.): 3,200 ft.; some projected deeper

Cost Averages, Per Ft. or Day

Footage price	$2.25
Day-work rate with drill pipe, per hour	$22.50

NOW

Dorrco D-Sander Available in Three Standard Sizes . . .

Mud Capacity
(at 20 psi operating pressure)

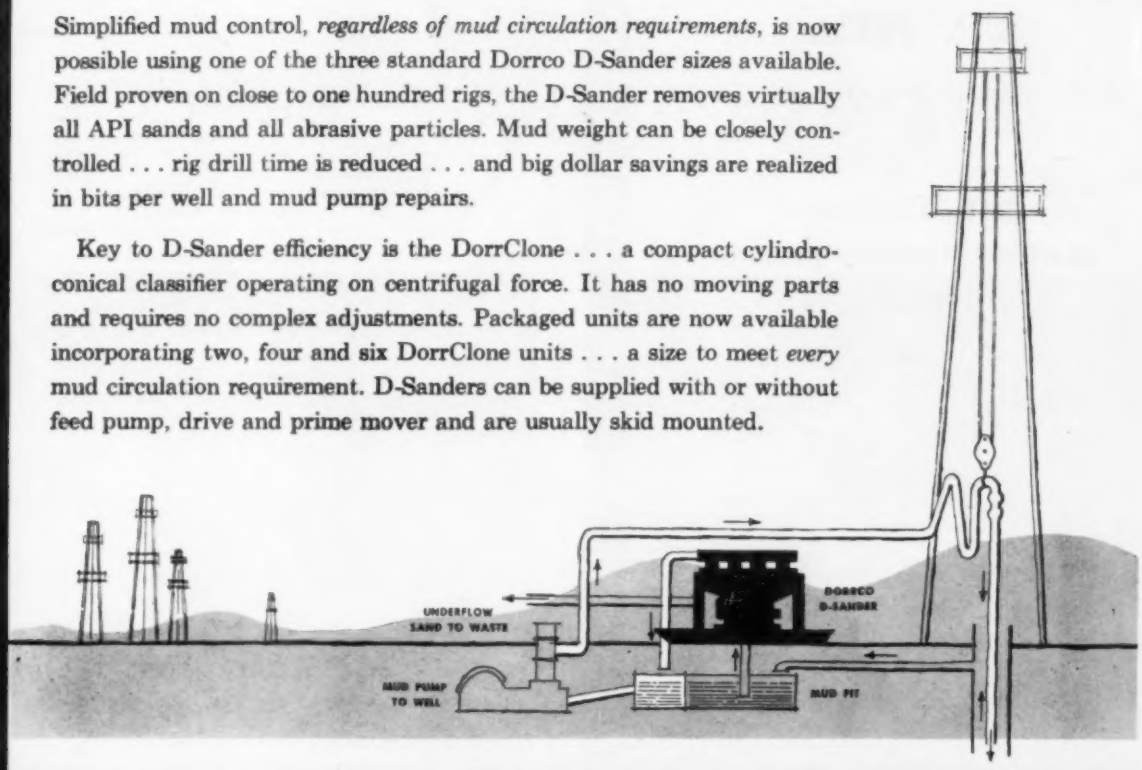
#2 D-Sander — 200-250 gpm

#4 D-Sander — 400-500 gpm

#6 D-Sander — 600-800 gpm

Simplified mud control, *regardless of mud circulation requirements*, is now possible using one of the three standard Dorrco D-Sander sizes available. Field proven on close to one hundred rigs, the D-Sander removes virtually all API sands and all abrasive particles. Mud weight can be closely controlled . . . rig drill time is reduced . . . and big dollar savings are realized in bits per well and mud pump repairs.

Key to D-Sander efficiency is the DorrClone . . . a compact cylindro-conical classifier operating on centrifugal force. It has no moving parts and requires no complex adjustments. Packaged units are now available incorporating two, four and six DorrClone units . . . a size to meet *every* mud circulation requirement. D-Sanders can be supplied with or without feed pump, drive and prime mover and are usually skid mounted.



For more information on the Dorrco D-Sander, contact our U. S. Sales Representative, Salt Water Control Inc., 1211 Fort Worth National Bank Building, Fort Worth 2, Texas.

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SELF-ALIGNING

SAND SEALED-OFF PUMPS

Figs. 600-800-900

Inverted Combination Single or Double Plunger Self-Aligning Pumps can be equipped with a Sand Flush Valve which seals the Plunger off on top and cleans the barrel every pump stroke.

Sand is deposited into blind cage above the plunger and is discharged every stroke of the pump. The bottom of plunger is sealed to eliminate slippage. Easy on surface equipment. Lower lifting cost with Sealed-Off Pumps.

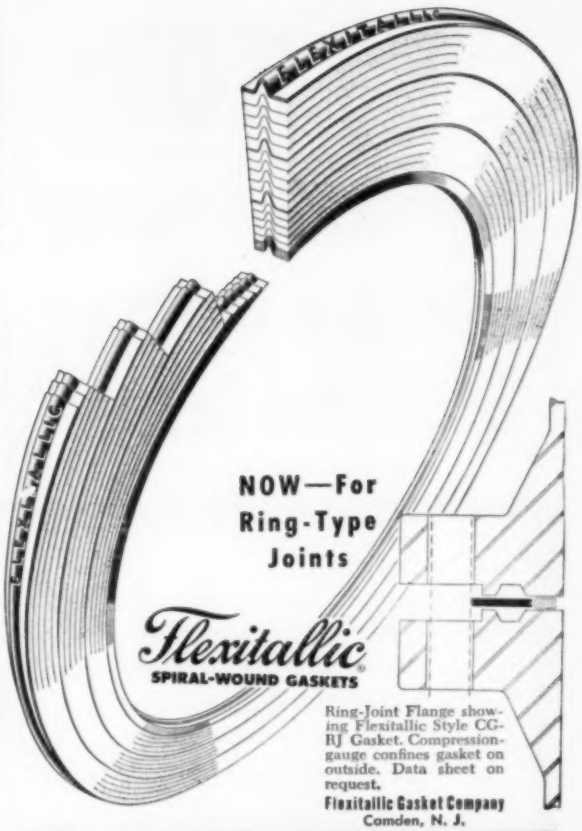
Can be run in any API seating device or use an adapter to fit the seating device preferred. We carry in stock at all times Special Heavy Duty Sand Housing Mechanical Seating Shoes which are very important to bad sand conditions—a place for sand to settle, so when pump is on down stroke, the bottom barrel bushing with a double spiral spray reaches into the sand housing, moving the sand upward and out of the tubing with the oil.

THOMPSON

PUMP COMPANY

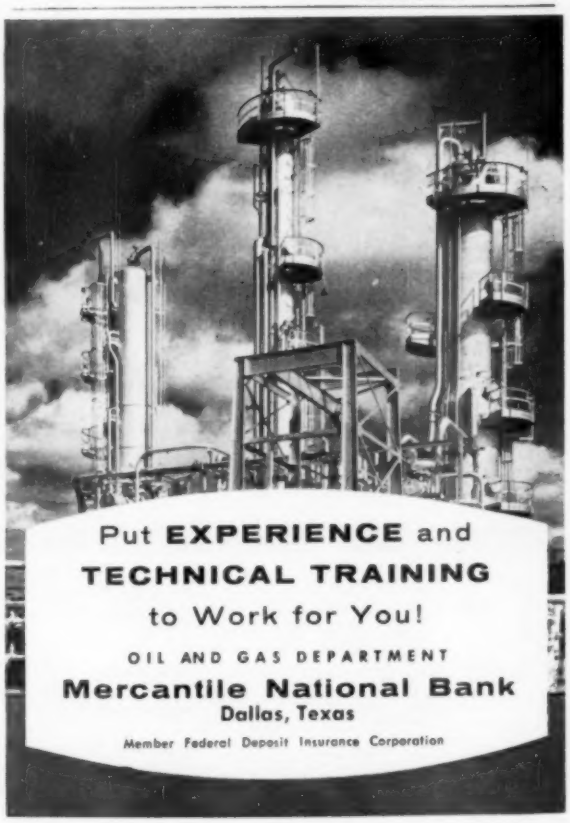
OKMULGEE, OKLAHOMA

Figs. 600-800-900



Ring-Joint Flange showing Flexitallic Style CG-RJ Gasket. Compression-gauge confines gasket on outside. Data sheet on request.

Flexitallic Gasket Company
Camden, N. J.



Day-work rate without drill pipe, per hour $21.00

Normal Rig-Time Distribution

Total days (spud to rig release)	5-11
Total number of bits	2½-3

Equipment

Fuel: Diesel, butane, gasoline.
Water supply: 300-ft. water wells.
Nearest supply center: Alice, Tex.
Terrain and roads: Sandy clay.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	150 to 650	100 to 400
Oil string	7-in. duals, 5½-in. single	3,200	450 plus

Remarks: Most operators using 150 ft. surface with 2 per cent calcium chloride; one operator is using 650 ft. of surface casing.

Typical Mud Program

Material—	Amount
Natural gel, sacks	50
Water loss agent, sacks	2

Tank truck moves mud from location to location.

Remarks: Actual drilling time under surface casing is 3 days minimum to 4½ days. Surface hole is drilled in about 6 hours average drilling time. When rig is used for coring and testing these operations require 50 per cent of the location time; 8 to 11 days on and off location. When rig is used to drill to total depth, log and sidewall core, then average time on and off location is about 5 or 6 days depending on time surface casing allowed to set. Some operators are using workover rig to finish the well—releasing the drilling unit as soon as possible after the plug has been pumped down on long string.

NORTH ORANGE FIELD
Orange County, Texas

Pay zone ..... Tertiary sands between 7,050 and 7,140 ft.
TD (avg.) ..... 7,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50
Day-work rate with drill pipe	$850.00
Day-work rate without drill pipe	$750.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	25
Total number of bits	14

Equipment

Fuel: Natural gas.
Water supply: Water well or bayou.
Nearest supply center: 15 miles.
Terrain and roads: Flat terrain, timbered.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,030	325 w/8%, 150 neat
Oil string	5½ or 7	7,500	500 neat

POESTA CREEK FIELD
Bee County, Texas

Pay zone ..... Sands at 2,650 ft., 2,680 ft., 2,750 ft., and 4,300 ft.
TD (avg.) ..... 4,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.35
Day-work rate with drill pipe	$700.00
Day-work rate without drill pipe	$650.00

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	7
Total number of bits	5

Equipment

Fuel: Natural gas, butane, diesel.
Water supply: Water well—300 ft. deep.
Nearest supply center: 40 miles.
Terrain and roads: Low hills, brush.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	400	235
Oil string	5½	3,000	300 w/ 12% gel; 250 neat

Remarks: Cement long string to surface.

Average Formation Tops

Formation—	Drilling depth (ft.)
Vicksburg	4,200

PART 3 A series on problems of stuffing box packing.

J-F...Perfect Pumping Package

BASIC CONSIDERATIONS

1. Packing
2. Rod
3. ALIGNMENT

Some phases of the alignment problem are the responsibility of the manufacturer, and some, of the producer. To assure alignment of the components manufactured by Johnson-Fagg, the following is exercised:

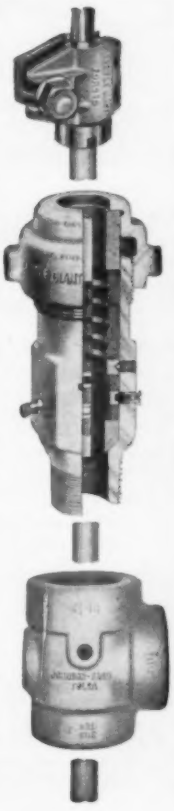
To assure straight and concentric threads in the Tee, J-F Pumping Tees are machined on an automatic indexing machine, indexing 90° for each threaded opening. All holes are bored with the proper taper before threading. Each Pumping Tee is gaged with both API thread gages and concentricity gages to assure perfect threads as well as perfectly aligned threads. This prevents the mis-alignment of stuffing box and Pumping Tee as related to the polished rod which, in turn, prevents egg-shaping of packing and shortening of packing life.

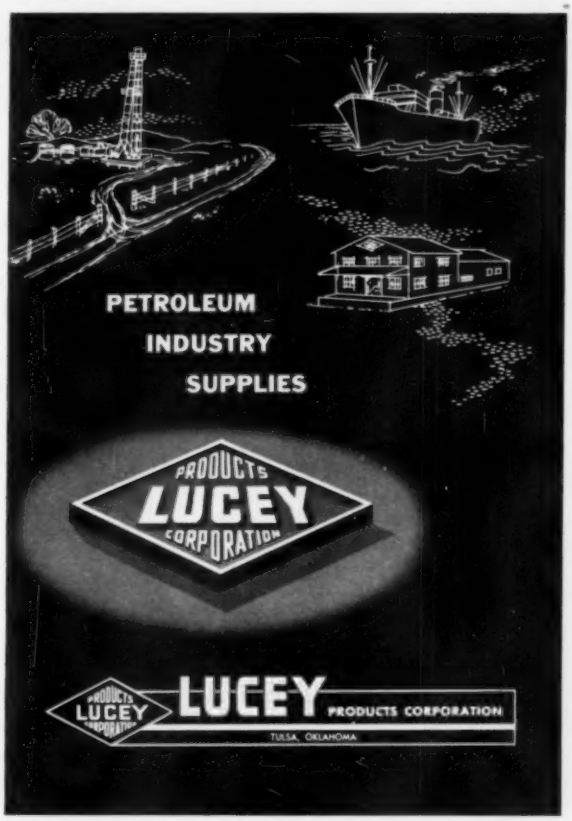
With the J-F Stuffing Box, equal care is taken in the top and bottom threading to insure proper alignment with the Tee as well as proper alignment with the center machined portion of the stuffing box.

The problem of proper alignment of the pumping unit over the well is the responsibility of the producer.

Bulletins PRL-257, SB-256 and T-255 present this information in more detail. They are available on request.

JOHNSON-FAGG, INC.
54th & Garnett Road — Phone Riverside 2-3337
P. O. Box 7157 — Tulsa, Oklahoma
Oil Field Pumping Specialists





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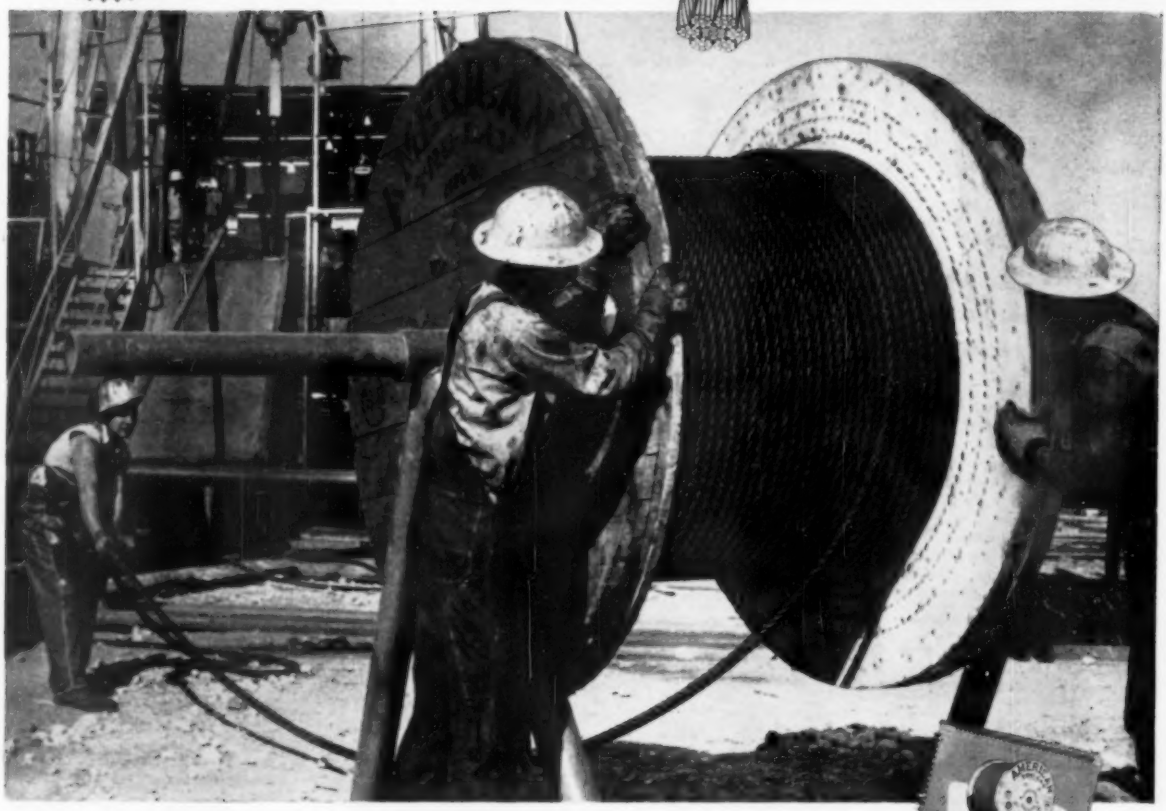
15% STRONGER



This 3-point control program will give you longer, safer rotary line life...

Stop guessing about how much service and safety you can expect from rotary drilling lines! Follow a definite line control program that is tailor-made to meet the specific requirements of your operation. More and more drillers are finding they can cut costs and get record breaking Ton-Mile performance from lines by following this simple 3-Point Control Program.

1. Use Only Tru-Lay VHS Lines. Made from a new grade of rope wire developed by ACCO's own process, VHS has 15% greater tensile strength than Improved Plow Steel. Also tougher and more wear resistant, VHS delivers more Ton-Mile service while resisting abrasion. And you can count on this great new rope to give you the highest safety factor available . . . a mighty important advantage at any depth . . . but especially at 10,000 ft. or below!

2. Buy Tru-Lay VHS in the longest practical length. Thus, with ample line reserve, cut-offs can be averaged-out to economically distribute wear and fatigue throughout the entire line.

3. Follow A Definite Cut-Off Schedule. Because practices vary from rig to rig and from location to location, it is essential for you to adhere to the specific cut-off schedule recommended for your operation.

For help in selecting the right cut-off practice for your lines, call our nearest field representative. When he visits you, he'll have a Ton-Mile Record Book containing reference tables and forms to assist you in carrying out his recommendations.

American Cable Division
AMERICAN CHAIN & CABLE

Bridgeport, Conn.
Factories at Wilkes-Barre, Pa., and Houston, Texas

ACCO
A·C·C
TRADE MARK

ACTIVE FIELDS

CAUGHLIN (STRAWN) FIELD
Wise County, Texas

Pay zone ..... Strawn (Pennsylvanian)
TD (avg.) ..... 4,150 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.00
Day-work rate with drill pipe	$600
Day-work rate without drill pipe	$500

Normal Rig-Time Distribution

Per cent on footage rate	91
Per cent on day-work rate	9
Total days (spud to rig release)	11
Total number of bits	11

Equipment

Fuel: Casing-head gas.
Water supply: Stock tanks.
Nearest supply center: Bridgeport, Tex.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	310	175
Oil string	5½ or 4½	4,150	350

Typical Mud Program

Material—	Amount
Gel and/or clay, sacks	210
Caustic, lb.	300
Quebracho, lb.	600
Soda ash, lb.	300

Average Formation Tops

Formation—	Drilling depth (ft.)
Base of Cretaceous	290
Bryson (Strawn)	2,250
Caughlin (Strawn)	3,980

REGULAR FIELD
Baylor County, Texas

Pay zone ..... Tannehill sand
TD (avg.) ..... 1,290 ft.

Cost Averages, Per Ft. or Day

Footage price	$1.75
Day-work rate with drill pipe	$450.00
Day-work rate without drill pipe	$350.00

Normal Rig-Time Distribution

Per cent on footage rate	92
Per cent on day-work rate	8
Total days (spud to rig release)	3
Total number of bits	3

Equipment

Fuel: Butane.
Water supply: Limited.
Nearest supply center: Wichita Falls.
Terrain and roads: Rolling—graded county roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	70	45
Oil string	4½	Top of pay	100

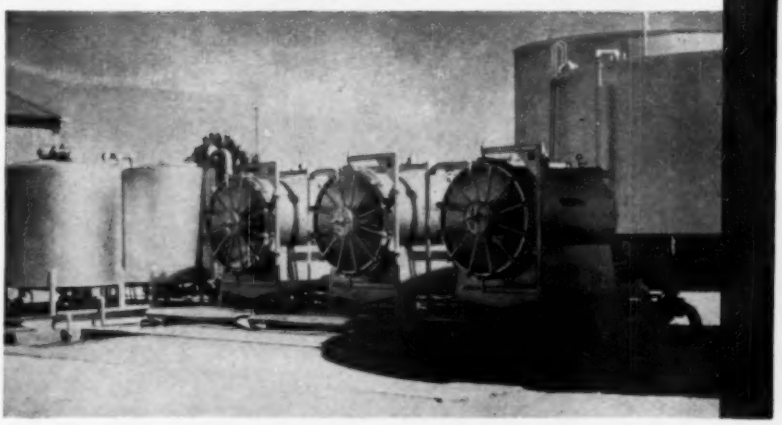
Typical Mud Program

Material—	Amount
Magcogel, sacks	32
Quebracho, sacks	1
Soda ash, sacks	6

Average Formation Tops

Formation—	Drilling depth (ft.)
Base Coleman Junction lime	926
Base Dothan lime	1,176

How to Keep
a Flood from
CHOKING TO DEATH



Identified as major causes of formation plugging are two microscopic miscreants—certain algae and several bacteria, particularly the sulfate-reducing bacteria. Counting on conventional treatment to remove these troublemakers is something like trying to trap mosquitoes with a picket fence ...most of them go right through and multiply mightily in the pores of the formation.

Diatomite filtration practically ends that threat by removing all algae and nearly all bacteria. That's the principal reason why many progressive operators today are filtering flood water with diatomite filter-aids such as Dicalite. Other advantageous features of diatomite filtration are the smaller space requirements, the lower capital investment and, most important, the complete salvability of a diatomite system.

An excellent example is this completely unitized diatomite filter system on a flood in West Texas. Three "Auto-Jet" filters, made by U.S. Filter Company, provide 1,500 ft² of filter area. 30,000 bbl/day of flood water go through this system; Dicalite Speedplus is being used as the filteraid. All units, including the precoat and slurry feeder tanks on the left, are skid-mounted for easy hauling.

For further information on Dicalite filtration of oilfield waters, write:

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ACTIVE FIELDS

DAY'S CHAPEL FIELD
Anderson County, Texas

Pay zone	Woodbine sand
TD (avg.)	5,300 ft

Cost Averages, Per Ft. or Day

Footage price	$2.50
Day-work rate with drill pipe	$650.00
Day-work rate without drill pipe	$550.00

Normal Rig-Time Distribution

Per cent on footage rate	60
Per cent on day-work rate	40
Total days (spud to rig release)	22
Total number of bits	7

Equipment

Fuel: Butane.
Water supply: Creeks.
Nearest supply center: Palestine.
Terrain and roads: Sandy roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	250-300	180 (2% gel)
Oil string	5½	5,400	140 (4%)

Remarks: D.V. tool at 2,800 ft. using 350 sacks.

Typical Mud Program

Material—	Amount
Quebracho, lb.	550
Caustic soda, lb.	500
Gel, lb.	23,700

Average Formation Tops

Formation—	Drilling depth (ft.)
Wilcox	Surface to 2,680
Midway	2,680
Pecan Gap	4,120
Austin chalk	4,900
Woodbine	5,125

LONGWOOD FIELD
Harrison County, East Texas

Pay zone	Fredricksburg lime
TD (avg.)	2,450 ft

Cost Averages, Per Ft. or Day

Footage price	$1.43
Day-work rate with drill pipe	$350.00

Normal Rig-Time Distribution

Total days (spud to rig release)	5
Total number of bits	2

Equipment

Fuel: Butane.
Water supply: Furnished by contractor.
Nearest supply center: Waskom, Tex.

Casing Program

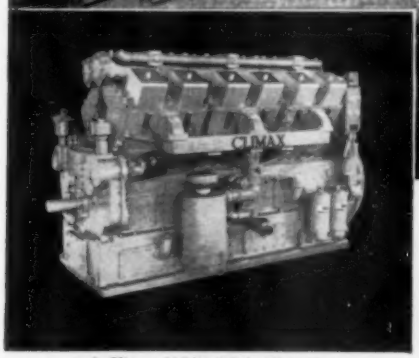
	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	220	100
Oil string	4½	2,460	175

Remarks: 4½-in. casing usually set 50 ft. in lime.

Average Formation Tops

Formation—	Drilling depth (ft.)
Fredricksburg lime	2,340-2,432

Remarks: Rotary rig drills well, sets 4½-in. production string and moves out. Cement sets 72 hours. Tubing rig is moved in; casing is perforated; tubing is run in pack-



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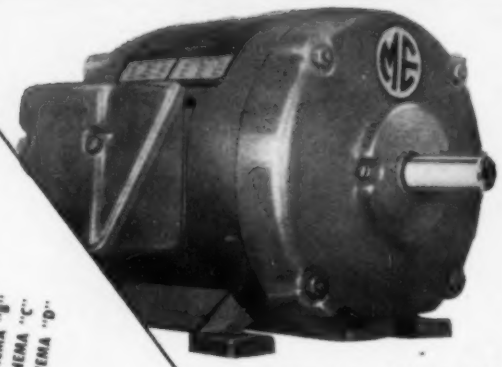

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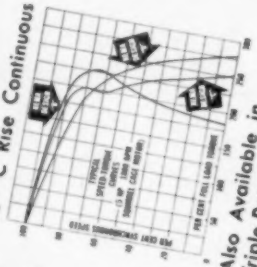

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GENERATORS
1/2 KW thru
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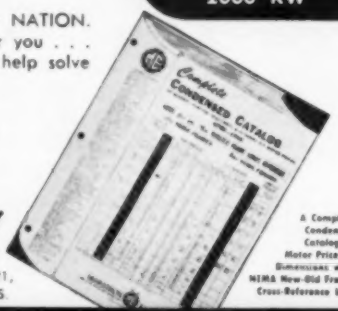

A Complete Condensed Catalog of Motor Prices & Dimensions with NEMA New-Old Frame Cross-Reference List.

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ACTIVE FIELDS

er. Well is fractured, all in 1 day—left shut in 24 hours then put in tank. ($12.50 per hour for tubing rig.)

RODESSA FIELD
Marion County, Texas

Pay zone	Gloyd limestone
TD (avg.)	6,650 ft.

Cost Averages, Per Ft. or Day

Footage price	$4
Day-work rate with drill pipe	$600
Day-work rate without drill pipe	$550

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	35
Total number of bits	15

Equipment

Fuel: Diesel fuel.
Water supply: Black Cypress Bayou.
Nearest supply center: Shreveport, La.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	824.91	300
Oil string	5½	6,651.07	450

Average Formation Tops

Formation—	Drilling depth (ft.)
First anhydrite stringer	5,290
Massive anhydrite	5,500
Lower anhydrite stringer	5,795
Hill	5,870
Gloyd	5,975
Pine Island	6,150
Sligo	6,495

TATUM FIELD
Panola County, Texas

Pay zone	Lower Pettet
TD (avg.)	6,800 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.75
Day-work rate with drill pipe	$750.00
Day-work rate without drill pipe	$700.00

Normal Rig-Time Distribution

Per cent on footage rate	87
Per cent on day-work rate	13
Total days (spud to rig release)	28
Total number of bits	16

Equipment

Fuel: Butane.
Water supply: Creeks.
Nearest supply center: Kilgore, Tex.
Terrain and roads: Rolling and fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	750	200
Oil string	5½	6,800	300

Typical Mud Program

Material—	Amount
Caustic soda, cans	30-100
Quebracho, sacks	60-50
Magcogel, sacks	25-100
Driscose, sacks	7-50

HANSFORD-MORROW FIELD
Hansford County, Texas

Pay zone	Morrow sands
TD (avg.)	7,450 ft.

Bring your CUMMINS diesel "back home" for service

You get factory-type service for trouble-free engine performance at any of the 15 Cummins service-repair branches. Factory-trained mechanics and genuine Cummins parts are available 24 hours a day.

15 FACTORY-TYPE SERVICE SHOPS

CUMMINS
Sales & Service, Inc.
General Offices: Mid-Continent Bldg.
FORT WORTH, TEXAS

ACTIVE FIELDS

Cost Averages, Per Ft. or Day

Footage price	$5.25
Day-work rate with drill pipe	$825.00
Day-work rate without drill pipe	$750.00

Normal Rig-Time Distribution

Per cent on footage rate	82
Per cent on day-work rate	18
Total days (spud to rig release)	38.5
Total number of bits	37

Equipment

Fuel: Gas.
Water supply: Water well.
Nearest supply center: Borger, Tex., 40 miles.
Terrain and roads: Level to rolling locations—native soil and caliche in low spots.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	7⅝	3,116.16	900 (8% gal)
Oil string	4½	7,326.67	400 (12% gel)

Remarks: 2-in. tubing, casing seat, 7,159.50 ft.

Typical Mud Program

Material—	Amount
Soda ash, lb.	1,500
Caustic soda, lb.	6,000
Mantan, lb.	9,000
Aquagel, lb.	94,700
Cottonseed hulls, lb.	66,300
Fibertex, lb.	10,500
Diesel oil, gal.	16,150

Average Formation Tops

Formation—	Drilling depth (ft.)
Douglas sand	5,000
Oswego sand	6,225
Base 13 finger lime	7,000
Top Morrow gas sands	7,050
Top Indian Belly swell	7,320
Top Mississippi lime	7,500

SPEARMAN, EAST, FIELD
Hansford County, Texas

Pay zone ... Atoka and lower Des Moines
TD (avg.) ... 7,100 ft.

Cost Averages, Per Ft. or Day

Footage price	$5.25
Day-work rate with drill pipe	$750.00
Day-work rate without drill pipe	$700.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	40
Total number of bits	26

Equipment

Fuel: Butane, propane.
Water supply: Irrigation ditches.
Nearest supply center: Spearman, Tex.
Terrain and roads: Partly rough—roads good in dry weather.

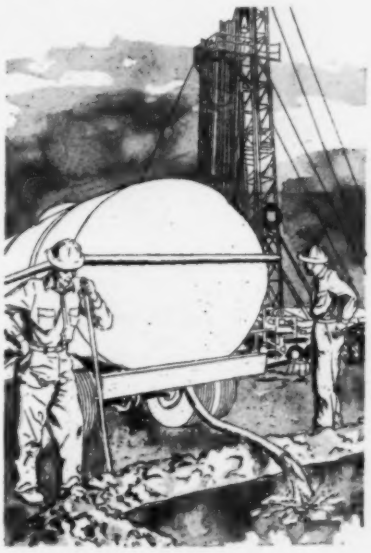
Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	3,200	900
Oil string	7	7,100	150-300

Typical Mud Program

Material—	Amount
Aquagel, tons	66
Soda ash, sacks	33
Fiber, sacks	1,080

Brine in the pit . . .



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Super-saturated brine will save you hundreds of dollars in workovers, completions, and drilling through salt sections.

Brine is about one-third the cost of drilling muds. Drilling salt sections with brine guarantees a bit size hole, thus saving hundreds of dollars on cement jobs. So when you use Ready-Made brine it's almost like putting money in the bank.

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Brine Service Co. — Houston, Corpus Christi
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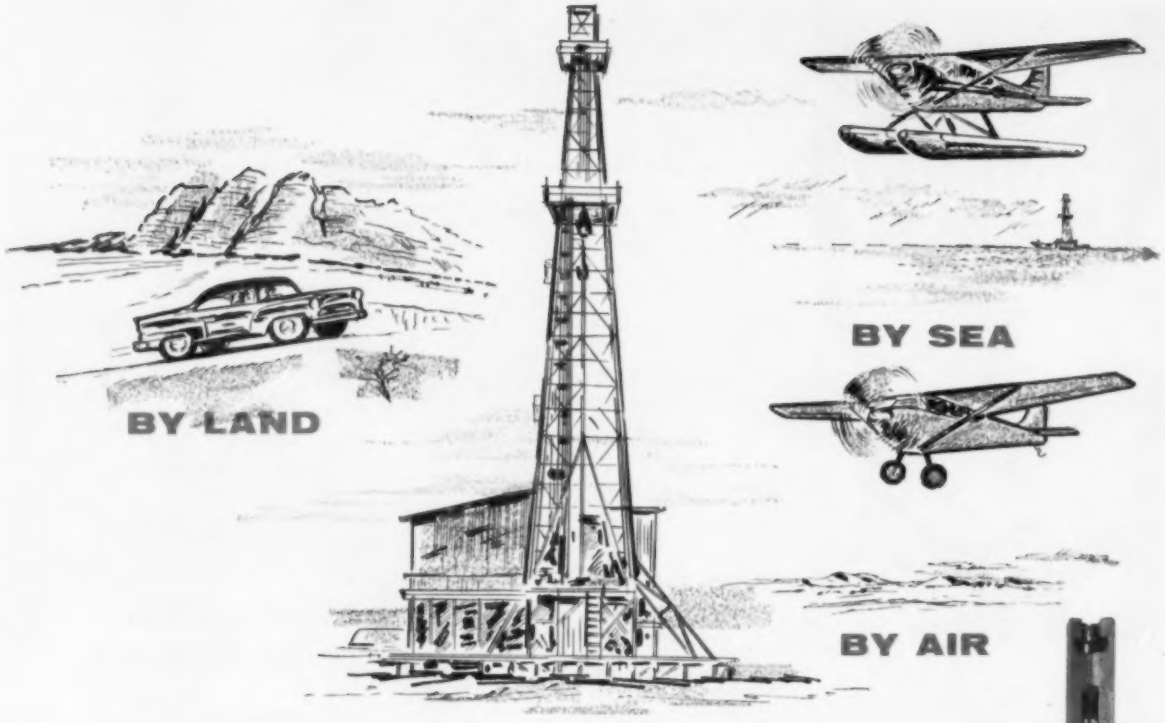
The Brine Co. — Midland, Tex.; Hobbs, N. M.



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PROVIDES 3-WAY SERVICE FOR ITS E-C STRAIGHT HOLE INSTRUMENT

Special land and float planes provide regular service to otherwise inaccessible locations with the familiar Sperry-Sun cars serving the more accessible locations.

The E-C Inclinometer is the most economical of rig time of any instrument for wire line operation, as it records automatically and immediately after coming to rest; and for absolute accuracy, it is self-checking and double-checking; in addition, it is able to make several records on one run—an E-C Inclinometer exclusive feature.

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1. Self-Checking
2. Double-Checking
3. Multiple Recording

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Caustic soda	44
Cottonseed hulls	1

Average Formation Tops

Formation—	Drilling depth (ft.)
Upper Des Moines	6,200
Lower Des Moines	6,400
Atoka	7,070

WEST PANHANDLE FIELD
Panhandle, Texas

Pay zone	Arkosic dolomite and granite wash
TD (avg.)	3,150 ft.

Cost Averages, Per Ft. or Day

Footage price	$3
Day-work rate with drill pipe	$600-$650
Day-work rate without drill pipe	$550-$600

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	7
Total number of bits	5

Equipment

Fuel: Gas.
Water supply: Truck.
Nearest supply center: Pampa.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	400+	175
Oil string	5½	3,150	80

Typical Mud Program

Material—	Amount
Magcogel, sacks	215
Salt, gel, sacks	26
Lime, sacks	12
Hulls, sacks	206
High yield, sacks	36

Average Formation Tops

Formation—	Drilling depth (ft.)
Brown dolomite	2,700
Arkosic dolomite	2,975
Red granite wash	3,175

Remarks: Completion with cable tools. Average about 5 days.

Louisiana

COLQUITT FIELD
Claiborne Parish, Louisiana

Pay zone	Smackover limestone
TD (avg.)	10,550 ft.

Cost Averages, Per Ft. or Day

Footage price	$8.63
Day-work rate with drill pipe	$863.00
Day-work rate without drill pipe	$738.00

Normal Rig-Time Distribution

Per cent on footage rate	71
Per cent on day-work rate	29
Total days (spud to rig release)	107
Total number of bits	90

Equipment

Fuel: Gas.
Water supply: Water wells.
Nearest supply center: Shreveport, La.
Terrain and roads: Rolling terrain.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	2,499	1,475
Oil string	7	10,529	478

Why the "Roustabout 1523" is the best all-purpose jack for drillers

First, the "Roustabout" (Jack No. 1523) has plenty of power—15-ton capacity for loads applied to either head or foot lift. Second, this well-balanced jack can work at any angle at full capacity (note swivel base). Third, its slotted head takes special claw or chain for lifting, lowering, pushing or pulling pipe, beams, poles, etc. Fourth, the "Roustabout" oil field jack is equipped with a patented adjustable spring mechanism which assures positive engagement of rack teeth. The spring's tension can be easily adjusted with a screw driver without removing any part of the jack. Send for Oil Field Jack Bulletin Ad-19B.

You can get the "Roustabout 1523" at your favorite supply store!

DUFF-NORTON **Duff-Norton Jacks**

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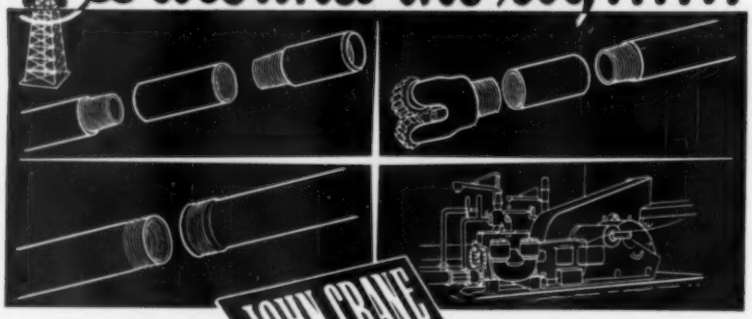
COFFING HOIST DIVISION: Danville, Illinois

Rachet Jacks, Screw Jacks, Hydraulic Jacks, Special Worm Gear Jacks, Rachet Hoists, Electric Hoists, Load Binders, Spur Gear Hoists

All around the rig.....



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These Two Products Provide

Longer Service • Better Performance

JOHN CRANE **PLS*** **PLASTIC LEAD SEAL**

for tool joints, rods, tubing casing and all other threaded connections and gaskets.

All-Purpose PLS non-hardening lead-base compound permanently protects and leakproofs all connections even at abnormally high pressures. Yet, it lubricates as it seals . . . prevents seizing . . . allows easy disassembly of joints at any time . . . eliminates galling and rust. PLS is insoluble in all petroleum products . . . never washes out . . . is economical to use, since it outlasts ordinary compounds and less is required to give a perfect seal. In 1, 5, 15 and 28-lb. pails.

Test prove PLS at our expense. Send for free sample today.

JOHN CRANE **Style 8820 EVERSEAL "V" PACKING**

especially fabricated for positive sealing, long-lasting operation on mud pumps.

Constructed of alternate homogenously molded graphitized asbestos material and synthetic rubber rings, with male and female adaptors. Special "V" design insures automatic sealing action at high or low pressures. Pressure chambers between rings break down total pressure and act as reservoirs which hold the liquid lubricant next to the plunger, thus reducing friction. Flexible lips automatically force against the rod on the pressure stroke and release on the suction stroke.

Carried in stock in all popular mud pump sizes.

Send for full information today.

See your local oil well supply store

Crane Packing Co., 6419 Oakton St., Morton Grove, Ill.

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140 North Marine Avenue
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6626 Supply Row
P.O. Box 9411
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Crane Packing Company
53 Stevenson Street
San Francisco 5, California

In Canada:
Crane Packing Co., Ltd., 617 Parkdale Avenue, N., Hamilton, Ont.

JOHN CRANE **CRANE PACKING COMPANY** 38 YEARS

Typical Mud Program

Material—	Amount
Macogel, sacks	600
Quebracho, sacks	259
Caustic, drums	288
High Yield, sacks	50
My-O-Gel, sacks	310
Lime, sacks	340
Driscose, sacks	80
Tannathin, sacks	180
Magcobar, sacks	2,315
Diesel oil, bbl.	314

Average Formation Tops

Formation—	Drilling depth (ft.)
Annona chalk	2,600
Ferrylake anhydrite	3,950
Hosston	5,950
Cotton Valley	7,400
Smackover	10,050

COLQUITT FIELD
Claiborne Parish, Louisiana

Pay zone	Taylor
TD (avg.)	9,170 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.00
Day-work rate with drill pipe	$863.00
Day-work rate without drill pipe	$763.00

Normal Rig-Time Distribution

Per cent on footage rate	87
Per cent on day-work rate	13
Total days (spud to rig release)	55
Total number of bits	58

Equipment

Fuel: Gas.
Water supply: Water wells.
Nearest supply center: Shreveport, La.
Terrain and roads: Gravel; rolling terrain.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	1,840	588
Oil string	5½	9,163	500

Typical Mud Program

Material—	Amount
Macogel, sacks	75
Quebracho, sacks	135
Caustic, drums	95
High yield, sacks	25
My-O-Gel, sacks	135
Lime, sacks	50
Kembreak, sacks	40
Diesel oil, bbl.	219

Average Formation Tops

Formation—	Drilling depth (ft.)
Annona chalk	2,600
Ferry Lake anhydrite	3,950
Hosston	5,950
Cotton Valley	7,400

GREENWOOD-WASKOM FIELD
Caddo Parish, Louisiana

Pay zone	Mooringsport
TD (avg.)	3,825 ft.

Cost Averages, Per Ft. or Day

Footage price	$2.00
Day-work rate with drill pipe	$450.00
Day-work rate without drill pipe	$375.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	12
Total number of bits	7

over 90% of the wells drilled in France used tools by BAASH*ROSS

"UC" CASING SLIPS
by Baash-Ross
have these features...

WRAP AROUND casing and exert uniform pressure at all points.

ALL SEGMENTS set at exactly the same level eliminating concentration of slip pressure and safeguarding the casing against bottle-necking or deformation.

DESIGNED AND MANUFACTURED to accommodate the longest and heaviest casing strings.

MAINTAIN perfect alignment at all times and automatically center the casing in the bushing.

For further information write P.O. Box 1343, Houston 1, Texas or see The Composite Catalog.

Because of the heavy weight of most casing strings and the relatively thin wall of the pipe, it is extremely important that the slips used for supporting casing strings be especially designed to insure a full-circumferential grip on the surface of the pipe. BAASH-ROSS TYPE "UC" CASING SLIPS eliminate the problems encountered when using other type casing slips. Buy through your supply store.

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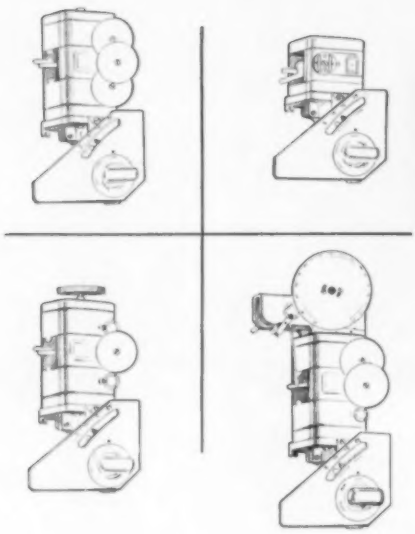

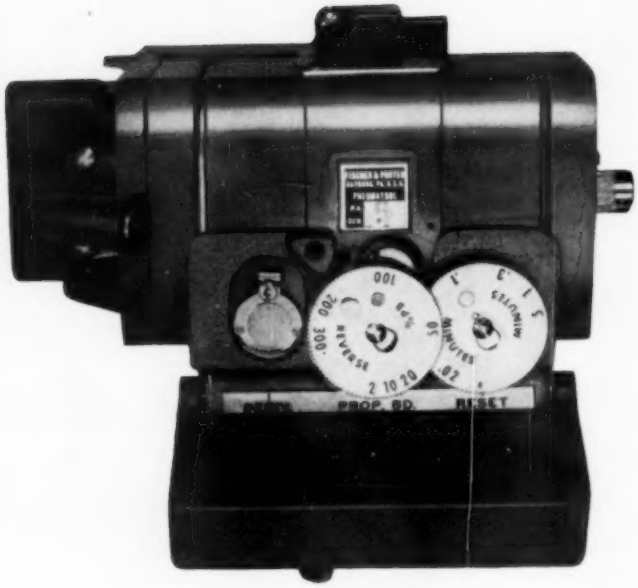

NOW . . . the P-4 controller is better than ever!

Back from a thorough redesign, the P-4 has more to offer than ever before. All the advantages proved in years of actual use have been retained . . . and more have been added. Chief among the improvements resulting from this complete re-evaluation are:

- Even *lower* steady state air consumption—and increased amplifying relay capacity
- Improved linearity plus increased gain in the error detection network
- Greater independence from dirty air supply
- Easily accessible external alignment adjustments
- Improved frequency response characteristics
- Greater flexibility—new "Universal" design provides 2-50% proportional action, on-off controller action, 2-100% differential gap action—in *one controller!*

Brilliant instrument design has permitted all these improvements with no change in bellows construction or motion balance principle of operation. In-case models still feature completely integrated *in-the-case* accessories, free of troublesome links or complex external members. And they can still be mounted left or right with equal ease, permitting two to a single case if desired. Of course, a complete line of plug-in models for use with miniature instruments is still available.

If you'd like to investigate the renewed P-4B controller first hand, call in the Fischer & Porter field engineer serving you . . . or write for new Catalog 53P-4000 to Fischer & Porter Co., 3207 County Line Road, Hatboro, Pa. In Canada, write Fischer & Porter (Canada) Ltd., 2700 Jane Street, Toronto, Ontario.

PERFORMANCE SPECIFICATIONS • SERIES 53P—P-4B CONTROLLERS

Output pressure—*3 to 15 or 3 to 18 psig*

Set point and process pressures for field or plug-in models—*3 to 15 psig*

Index tracking at any output pressure—*within 1% of scale (Reset controller)*

Temperature limit—*225 F*

Supply pressure—*17 to 22 psig*

Zero frequency gain (Reset controller)—*approximately 300*

Derivative gain—*approximately 12*

Field mounting manifold cut-off valve—*air to open*

Steady state air consumption—*0.08 scfm*

	In Case Controllers	Plug-In And Field Mounted
On-off	53PR 4101	
"Universal" controller; 2-50% proportional, on-off, and 2-100% differential gap	53PR 4241	53PN 4240
Proportional only	53PR 4301	53PN 4300
Proportional plus fast derivative	53PR 4411	53PN 4410
Proportional plus slow derivative	53PR 4421	53PN 4420
Proportional plus fast reset	53PR 4511	53PN 4510
Proportional plus slow reset	53PR 4521	53PN 4520
Proportional plus fast derivative plus fast reset	53PR 4611	53PN 4610
Proportional plus fast derivative plus slow reset	53PR 4631	53PN 4630
Proportional plus slow derivative plus slow reset	53PR 4621	53PN 4620
Ratio—Proportional plus fast reset	53PP 4511	

FP

FISCHER & PORTER CO.

Complete Process Instrumentation

ACTIVE FIELDS

Equipment

Fuel: Diesel.
Nearest supply center: Shreveport.
Terrain and roads: Hilly—fair.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	400-420	180
Oil string	4½	3,850	285

Average Formation Tops

Formation—	Drilling depth (ft.)
Mooringsport	3,770-3,775

RED ROCK FIELD
Webster Parish, Louisiana

Pay zone — Smackover limestone
TD (avg.) — 11,470 ft.

Normal Rig-Time Distribution

Per cent on footage rate	83
Per cent on day-work rate	17
Total days (spud to rig release)	108
Total number of bits	121

Equipment

Fuel: Gas.
Water supply: Wells.
Nearest supply center: Haynesville, La.
Terrain and roads: Good.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	200	250
Intermediate	10¾	2,610	1,850
Oil string	5½	11,380	500

Typical Mud Program

Material—	Amount
Aquagel, lb.	29,300
Baroid, lb.	105,800
Carbonox, lb.	21,150
Caustic soda, lb.	18,700
Lime, lb.	14,100
Quebracho, lb.	2,500
Tannex, lb.	3,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Tokio	3,025
Cotton Valley	7,560
Taylor	9,230
Smackover "B"	11,065

BAYOU CHOCTAW FIELD
Iberville Parish, Louisiana

Pay zone — Miocene sands between 3,500-8,000 ft.
TD (avg.) — 6,000 ft.

Cost Averages, Per Ft. or Day

Footage price	$4-$5
Day-work rate with drill pipe	$850-$950
Day-work rate without drill pipe	$700-$900

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	30
Total number of bits	20

Equipment

Fuel: Field gas.
Water supply: Water wells.
Nearest supply center: Baton Rouge and Houma.
Terrain and roads: Swamp operations.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	800-1,500	To surface
Oil string	7	6,000-8,500	500

Remarks: Complexly faulted area and sands are designated by a company numerical system. Natural mud is used in wells above 6,000 ft. deep. In the deeper wells, operators use natural mud to 7,500 ft. and convert to a lime-base mud to total depth.

BAYOU PENCHANT FIELD
Terrebonne Parish, Louisiana

Pay zone — Miocene sand at 13,630-40 ft.
TD (avg.) — 14,800 ft.

Cost Averages, Per Ft. or Day

Footage price — $4 per ft. to 10,500 ft. (and $1,400 per day below this depth)
Drill-pipe rental — 1½ cents per ft. per day

Normal Rig-Time Distribution

Per cent on footage rate	71
Per cent on day-work rate	29
Total days (spud to rig release)	122
Total number of bits	42

Equipment

Fuel: Diesel.
Water supply: Bayous.
Nearest supply center: Bayou Boeuf.
Terrain and roads: Low, swampy land; requires corals.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	3,092	2,500
Intermediate	9⅝	11,850	1,000
Oil string	7	14,196	1,500

Remarks: Operators use a red mud with a low pH weighing 12.5 lb. per gallon at the protective casing. Below this depth they convert to a gypsum mud weighing 17.6 lb. per gallon.

CAILLOU ISLAND FIELD
Terrebonne Parish, Louisiana

Pay zone — Miocene sands between 11,800 and 12,300 ft.
TD (avg.) — 12,650 ft.

Cost Averages, Per Ft. or Day

Footage price — $5.50 to 11,000 ft.
Day-work rate with drill pipe — $1,675 plus $0.015 per ft. for drill pipe

Normal Rig-Time Distribution

Per cent on footage rate	50
Per cent on day-work rate	50
Total days (spud to rig release)	42
Total number of bits	22

Equipment

Fuel: Diesel.
Terrain and roads: Water locations.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	2,400	1,200
Oil string	7	12,600	600

EAST LAKE PALOURDE FIELD
Assumption Parish, Louisiana

Pay zone — 12,000-13,500 ft. (Miocene sands)
TD (avg.) — 13,500 ft.

Cost Averages, Per Ft. or Day

Footage price — $4 to $5
Day-work rate with drill pipe — $1,400-$1,600

BALLS OF KENTANIUM*

keep the pump down longer . . . keep production and profits up . . . provide exceptionally high resistance to

. . . fluid cutting
. . . wear
. . . corrosion
. . . ball pounding
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Kentanium is one-third lighter than steel, one-half lighter than tungsten-carbide.

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- VERMIN PROOF
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Yes . . . all these features are combined in Fieldmaster Ball Bearing Motors to make them the leading power units in the oil country. Naturally there's a type and H.P. especially suited to fit your specific requirements.

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BETHLEHEM SUPPLY COMPANY
TULSA, OKLAHOMA
Manufactured by
VALLEY ELECTRIC CORP.
ST. LOUIS 8, MISSOURI

ACTIVE FIELDS

Day-work rate without drill pipe ..... $1,300-$1,500

Normal Rig-Time Distribution

Per cent on footage rate	50
Per cent on day-work rate	50
Total days (spud to rig release)	60.7
Total number of bits	25 to 35

Equipment

Fuel: Gas and diesel.
Water supply: Canal.
Nearest supply center: Morgan City.
Terrain and roads: Canals and bayous; water operations.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	230	300
Intermediate	10¾	3,500	410
Oil string	7	13,500	380

Typical Mud Program

Material—	Amount
Weight, material, lb.	82,100
Gel, lb.	54,400
Caustic soda, lb.	9,475
Quebracho, lb.	11,525
Lime, lb.	12,450
C.M.C., lb.	4,025

MONTEGUT FIELD
Terrebonne Parish, Louisiana

Pay zone ..... Miocene sands at 11,250 ft. and 12,400 ft.
TD (avg.) ..... 12,500 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$1,100.00
Day-work rate without drill pipe	$1,000.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	35
Total number of bits	24

Equipment

Fuel: Natural gas.
Water supply: Canals.
Nearest supply center: Houma.
Terrain and roads: Marsh and swamp. Board roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	2,500	1,200 cu. ft.
Oil string	7	12,800	1,000 cu. ft.

Average Formation Tops

Formation—	Drilling depth (ft.)
Texularia "W"-1 (gas sand)	11,250
Texularia "W"-3 (gas sand)	11,750
Texularia "W"-6 (gas and oil sand)	12,200
Texularia "W"-0 (oil sand)	12,320

Remarks: High-pressure salt-water sand about 13,500 ft.

WEST HACKBERRY FIELD
Cameron Parish, Louisiana

Pay zone ..... Camerina sand
TD (avg.) ..... 7,000 ft.

Cost Averages, Per Ft. or Day

Footage price $4
Day-work rate with drill pipe $850
Day-work rate without drill pipe $750

Normal Rig-Time Distribution

Per cent on footage rate	95
Per cent on day-work rate	5
Total days (spud to rig release)	12
Total number of bits	9

Equipment

Fuel: Butane.
Water supply: Water well.
Nearest supply center: 45 miles.
Terrain and roads: Flat—grassland

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,400	450 w/8% gel, 150 neat
Oil string	5½	7,000	500

Remarks: Depth of pay zone from 6,000 to 8,000 ft. Formation tops vary considerably due to sharp dip of beds (60°).

Southeastern United States

PISTOL RIDGE-MAXIE FIELD
Forrest County, Mississippi

Pay zone ..... Wilcox, Eutaw, Tuscaloosa, Pigford and Nelson
TD (avg.) ..... 8,400 ft.

Cost Averages, Per Ft. or Day

Footage price:	
(Wilcox)	$2.75
(Eutaw)	$3.35
(Massive)	$4.25
Day-work rate with drill pipe	$800.00
Day-work rate without drill pipe	$725.00

Normal Rig-Time Distribution

Per cent on footage rate	90
Per cent on day-work rate	10
Total days (spud to rig release)	40
Total number of bits	25

Equipment

Fuel: Natural gas or diesel.
Water supply: Streams.
Nearest supply center: Laurel.
Terrain and roads: Terrain rolling, roads adequate.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	16	40	60
Intermediate	10¾	1,600	1,200
Oil string	7	8,480	1,000

Typical Mud Program

Water-base mud ..... Cost, approx. $3,000

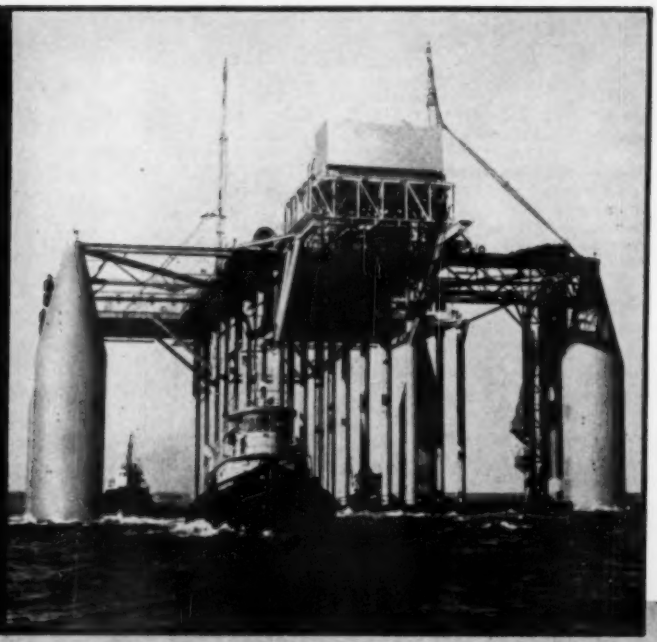
Average Formation Tops

Formation—	Drilling depth (ft.)
Wilcox	4,450
Eutaw	7,250
Lower Tuscaloosa	8,250
Pigford	9,080

TRI-STATE FIELD
(Indiana, Illinois, Kentucky) Hamilton County, Illinois

Pay zone ..... McClosky lime
TD (avg.) ..... 3,300 ft.

INGALLS-BUILT "GIANTS" search out oil pockets on the gulf's continental shelf!



"Giant among giants" is the *Kermac 46*, among the largest submersible oil drilling platforms ever to go to sea! Built by INGALLS for Kerr-McGee Oil Industries, Inc., the *Kermac 46* has air-conditioned accommodations for a crew of 50 . . . can sink six wells without relocating in water up to 70 feet deep. If your offshore drilling job calls for imagination and economy, experience and technical skills . . . consult a specialist—INGALLS.

Now under construction at Pascagoula are two new submersible oil drilling platforms, both closely following the design of the *Kermac 46*. Pictured is the second section of the Movible Offshore Drilling Company's "rig." After being joined to a similar section in INGALLS Wet Dock, it will be outfitted and moved into the Gulf of Mexico for offshore drilling operations.

A third huge rig, "Blue Water #1," built by INGALLS for the Blue Water Drilling Corporation, was commissioned on September 6, 1957.

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DESIGNERS and BUILDERS of Passenger Vessels, Tankers, Cargo Vessels, Naval Vessels, Barges, Towboats, Yachts

ENGINEERS: For jobs with a future, contact Ingalls today

ACTIVE FIELDS

Cost Averages, Per Ft. or Day

Footage price	$3.40 to $3.60
Day-work rate with drill pipe	$420.00
Day-work rate without drill pipe	$420.00

Normal Rig-Time Distribution

Days on footage rate	8 to 9
Days on day-work rate	2
Total days (spud to rig release)	10 to 11
Total number of bits	14

Equipment

Fuel: Diesel.

Water supply: Purchased—$500 per well average.
Nearest supply center: 10 miles—McLeansboro, Ill.
Terrain and roads: Mostly graveled; good terrain.

Casing Program

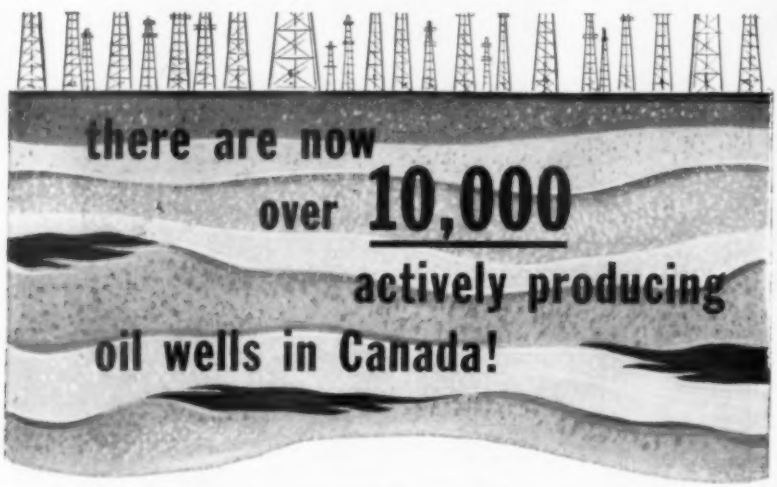
	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	80	60
Oil string	5½	3,300	200

Typical Mud Program

Material—	Amount
Bentonite, sacks	163
Soda ash and caustic soda, lb.	500
Quebracho, lb.	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Palestine sand	2,120
Menard lime	2,280
Glen Dean lime	2,585
Hardinsburg sand	2,615
Barlow	2,810
Cypress sand	2,830
Paint Creek sand	2,970
Renault	3,060
Aux Vases	3,120
Ste. Genevieve	3,175



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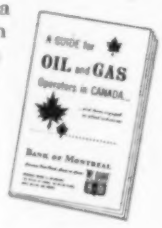
Canada's First Bank—with more than 250 offices throughout the oil-rich provinces of western Canada... has been intimately associated with the Canadian oil industry throughout 10 years of continuous discovery and fabulous growth.

"A Guide for Oil and Gas Operators in Canada" is a new, fact-filled brochure published by the B of M with comprehensive data on the disposition of petroleum rights north of the border. Write for a copy... or ask Bank of Montreal any questions on Canadian oil.



For a prompt response to your inquiry, contact C. A. P. Leahey, Special Representative, Bank of Montreal, Calgary Main Office, 140 Eighth Avenue West, Calgary, Alberta, Canada (Telephone AMherst 6-8701)

No Stock Recommendations

While the Bank is prepared to provide all available information on the oil industry, it does not make recommendations regarding the purchase of individual oil stocks.

"MY BANK" TO 5 MILLION CANADIANS
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Canada

FENN-BIG VALLEY FIELD
Alberta, Canada

Pay zone D-2 and D-3 (Devonian)
TD (avg.) 5,400 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.75
Day-work rate with drill pipe	$792.00
Day-work rate without drill pipe	$744.00

Normal Rig-Time Distribution

Per cent on footage rate	87
Per cent on day-work rate	13
Total days (spud to rig release)	23
Total number of bits	16

Equipment

Fuel: Diesel.
Water supply: Ditches, ponds.
Nearest supply center: Stettler.
Terrain and roads: Hilly; mud and gravel.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	500
Oil string	7 or 5½	5,390	650

Typical Mud Program

Material—	Amount
Gel, sacks	100
Preservative, lb.	375
Plaster of paris, lb.	35
Caustic, lb.	250
Starch, sacks	75
Lost circulation material, sacks	20

Average Formation Tops

Formation—	Drilling depth (ft.)
D-2	5,250
D-3	5,400

Remarks: Majority of rig time on day-work rate is result of coring.

HARMATTAN FIELD
Alberta, Canada

Pay zone Mississippian
TD (avg.) 9,200 ft.

Cost Averages, Per Ft. or Day

Footage price	$7.75-$8.00
Day-work rate with drill pipe	$1,113.00

Normal Rig-Time Distribution

Per cent on footage rate	79
Per cent on day-work rate	21
Total days (spud to rig release)	38-48
Total number of bits	42

Equipment

Fuel: Diesel oil.
Water supply: River and water wells.

On land . . . or sea

You can get uniform mud in seconds

CHANGE MUD IN SECONDS with one or two of these LIGHTNIN Mud Mixers. Their big rotating turbines create a powerful mud flow, sweeping every corner of your tank or pit. Your mud is kept uniform, all of it ready for instant use.

On offshore drilling tenders—on the world's deepest holes—all up and down the oil country, drilling men are getting an *immediate* rise in mud weight whenever they want it.

You can condition mud this same fast way by installing LIGHTNIN Mixers in your tank or pit. With LIGHTNINS on the job, you get immediate dispersion of weight and gel additions. Heavier, thicker mud is yours the moment you want it.

Mud stays uniform

One or two LIGHTNIN Mixers keep the mud uniform, too—every gallon the same weight and viscosity. Large turbine impellers set up such a strong, steady flow that mud just can't settle out.

Unconditionally guaranteed

You take no risk when you choose LIGHTNIN Mixers for your drilling mud. Every LIGHTNIN is guaranteed, unconditionally, to do the mixing job for which it is recommended.

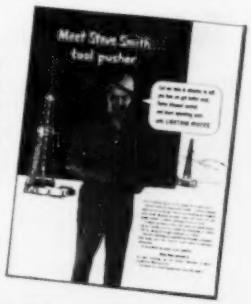
LIGHTNINS are fast becoming standard equipment on offshore drilling barges and in land tanks and earthen pits, too.

Seeing is believing

Tell your LIGHTNIN sales engineer or supply company representative you want to see for yourself how good LIGHTNIN mud control really is. He'll arrange a visit to a rig in your area where LIGHTNIN Mixers are at work.

You'll find his name listed in the Composite Catalog. Contact him right away—or write us direct.

FOR QUICK FACTS on LIGHTNIN mud control, send us a card today requesting free illustrated Bulletin B-502.



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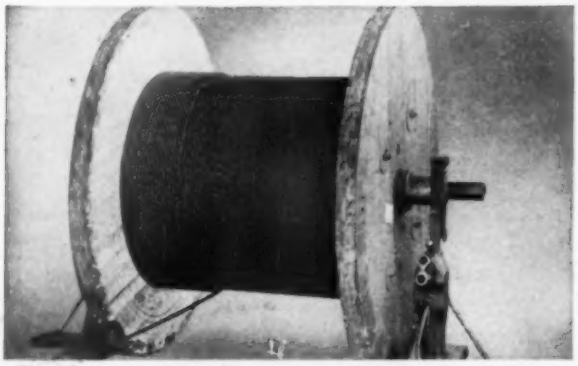
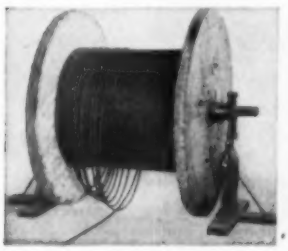
Tuffy Wire Rope Tips



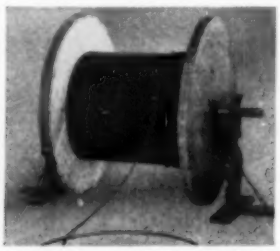
Here's the way to set up reel for unwinding

The stock reel should be set up on jacks, so the rope will come from the under side of the reel as shown in this picture.



This reel is set up right

Unwinding has started, and the reel is spinning faster than the rope is being pulled off. But because it's coming from the under side of the reel, the rope is simply loosening on the reel, with no damage.



This reel is set up wrong

The rope is coming from the top of the reel and forming loops as the reel over-runs. These loops are likely to form kinks and dog-legs, which can be ruinous to rope life.

Eight steps of correct SOCKETING

1. Securely seize and serve with soft wire ties before cutting, and have at least two additional seizings placed at a distance from the end equal to the length of the basket of the socket.

2. When the rope is properly seized, take off the end seizing. Cut the fiber center back to the seizing, as shown in Fig. 1 above. Untwist and broom out the wires. See Fig. 2.

3. Clean the wires for the distance they are to be inserted in the socket. Use benzine, naphtha or gasoline. Then dip the wires in commercial muriatic acid, to a depth not greater than ¾ of the cleaned length of wire. Keep them immersed for 30 seconds to 1 minute, or until the acid has thoroughly cleaned each wire. Be sure acid does not contact any other portion of the rope.

Follow these steps for PROPER SEIZING

Since practically all wire ropes today are preformed, we suggest that when cutting you put only one seizing on each side of the cut.

When cutting ordinary ropes, thoroughly seize (bind, serve or tie) so there will be no misplacement or relative movement of strands. For most ropes, other than preformed, *three* seizings should be used on each side of the cut. *Four* seizings on each side are required for a lang lay rope, or any rope having an independent wire rope core or a wire strand core. *Four* seizings are also needed for all 18x7 ropes, and all ropes larger than 1" diameter.

Tuffy Special Wire Ropes are tailored to special use. Ordering is easy:

Tuffy Rotary Lines

← Standard . . .
For use with standard rigs drilling in any formation. Also for deep drilling beyond 6000 ft. with jackknife rigs. Spools easily, pays off by delivering more ton-miles before cutting is necessary.

Or Jackknife →
An extra-flexible rope, spools smoothly on small sheave and drums of jackknife rigs drilling to 6000 feet. Top flight performer on jackknife rigs of all types.

Ton-Mile Indicator and Log Book. Provides a slide-chart method of figuring ton-miles quickly and easily, and with it you get a log book in which to record your ton-mile record.

Cut-Off Practice Book. Outlines the quick easy way to tell when to cut-off and how much. Shows how to obtain maximum service from rotary lines and avoid cutting too much, too soon, or too little too late. Carries cut-off tables for derricks of all heights with the various draw works operating in all the major oil territories.

Handbook of Wire Rope of Well Drilling and Servicing. More than 40 pages of useful facts on wire rope for rotary cable tool drilling and well servicing. Includes sizes and constructions of wire rope for all oil field services, its care, lubrication, abuses, correct handling, seizing and socketing.

FREE Write today for your copy

Watch your steps

when you unwind, seize, clip, socket and reeve wire rope

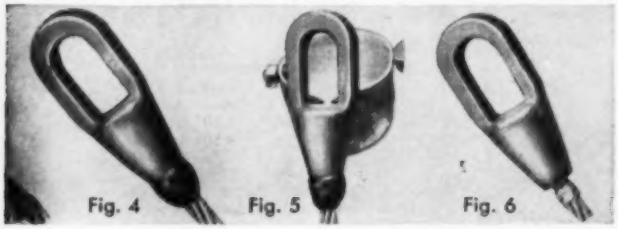


Fig. 4 Fig. 5 Fig. 6

4. Dip the wires in boiling water containing a small amount of soda, to neutralize the acid.

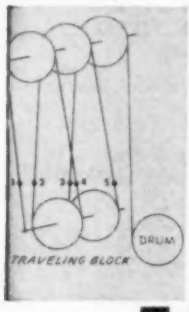
5. Place a temporary tie wire over the ends of the cleaned wire (see Fig. 3). Be careful not to get the cleaned wires greasy or oily.

6. Insert the rope end into bottom of socket. Remove temporary tie wire.

7. Holding the rope vertically in a vise, set the socket so that the wires are flush with top of the socket basket and seal the bottom with putty or clay (Fig. 4). Pour in among the wires about ½ teaspoon of sal ammoniac crystals.

8. Pour molten zinc into the basket to fill (Fig. 5). When zinc is solidified, remove seal. Socketing is complete as shown in Fig. 6.

REEVING



Reeving ropes through the sheaves multiplies the number of parts supporting the load. The lead line to the drum carries the weight of the load lifted, divided by the number of parts, plus the accumulation of friction on all sheaves.

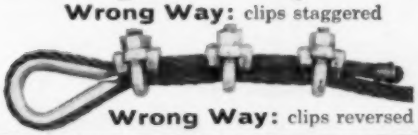
Here's how to count the number of parts supporting the load. Draw an imaginary line across the parts of the rope supporting the load.

The efficiency of reeving systems ranging from one to eight parts is shown in charts which Union Wire Rope engineers make available to users.

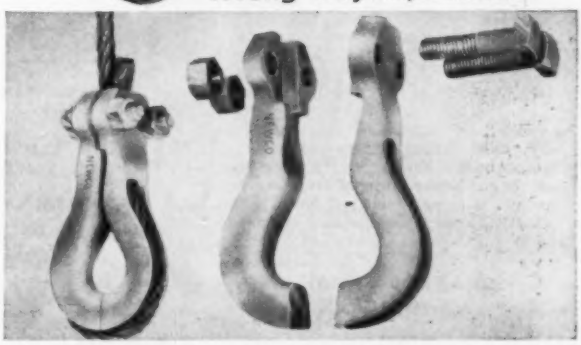
Attaching by CLIPPING

RIGHT WAY for greatest rope strength

Wrong Way: clips staggered



Wrong Way: clips reversed



The fitting you use on wire rope can handicap it or enable it to work at full efficiency. Fittings which derive holding power from crimping action are harmful to the rope.

Shown here is a clamp that has no wrong side—can be put on either way. It snugly saddles the rope, grips larger surface area in such a way that loads are carried almost solely by friction rather than by crimping action. Combined in its two parts is a thimble and the parts are interlocking to prevent collapse of the thimble and to eliminate all shear on the bolts.

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Tuffy Slings are made of a patented, machine-braided fabric that stays extra flexible, and isn't materially damaged by knotting or kinking. They have streamlined metal ferrules pressed on over tucked eye splices. The eye splice has full strength of the fabric. **Tuffy Hoist Lines** are a longer running rope on overhead, stiff leg and mobile cranes, clamshells and derricks.

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ASK YOUR UNION DISTRIBUTOR

Whether your wire rope need is a scheduled replacement or emergency requirement, your Union distributor is ready with "right-now" service. He keeps complete warehouse stocks of Union standard constructions and the Tuffy special purpose ropes. And he's backed by immediate service from his nearby Union Wire Rope depot.

If it isn't rope you need, but advice on a wire rope problem, he's just as ready to help. Just say the word!

If you don't know him already, see your classified telephone directory, under Wire Ropes or Slings.

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2102 Manchester Avenue, Kansas City 26, Mo.

3

Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand

Nearest supply center: Calgary and Olds.
Terrain and roads: Pavement and gravel; hilly.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	450
Oil string	5½	9,200	900

Remarks: Regular Pozmix cement is used. Casing accessories consist of float collar, float shoe, 7 centralizers, and 20 scratchers. Stop collars are used to eliminate welding on the N-80 casing. A chemical wash is displaced ahead of the cement slurry.

Typical Mud Program

Material—	Amount
Caustic soda, lb.	2,500
Bentonite, sacks	605
Pellite, lb.	1,850
Quebracho, lb.	1,250
S.A.P.P., lb.	300
Separan, lb.	300

Average Formation Tops

Formation—	Drilling depth (ft.)
Belly River	4,863
Cardium	7,128
Viking	8,127
Home sand	8,785
Turner Valley	9,099

Remarks: Lost circulation occurs occasionally while drilling surface hole due to gravel beds. Infrequently, high-pressure gas is encountered in the Colorado formation at approximately 7,500 ft. This necessitates weighting the mud column to 11 lb. plus.

KAYBOB FIELD
Alberta, Canada

Pay zone Beaverhill Lake, 9,610-9,701 ft.
TD (avg.) 10,045 ft.

Cost Averages, Per Ft. or Day

Day-work rate with drill pipe	$1,125
Day-work rate without drill pipe	$1,025

Normal Rig-Time Distribution

Per cent on day-work rate	100
Total days (spud to rig release)	90
Total number of bits	52

Equipment

Water supply: Local.
Nearest supply center: Calgary and Edmonton.
Terrain and roads: Muskeg and Lakes.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	13⅜	1,500	
Oil string	7	9,800	765

Typical Mud Program

Material—	Amount
Driscose, lb.	4,000
Caustic, lb.	4,000
Quebracho, lb.	4,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Cardium	3,361
Viking	4,659
Mississippian	6,030
Exshaw	7,224
Beaverhill Lake	9,438

KEYSTONE AREA FIELD
Alberta, Canada

Pay zone Cardium sand
TD (avg.) 4,400 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe	$840.00
Day-work rate without drill pipe	$840.00

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	14
Total number of bits	8

Equipment

Fuel: Diesel.
Water supply: Ponds.
Nearest supply center: Edmonton, Alta.
Terrain and roads: Rough.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	450
Oil string	5½	4,400	430

Typical Mud Program

Material—	Amount
Magcobar, sacks	350- 400
Magcogel, sacks	100- 150
Tanathin, lb.	1,000-1,500
Sapp, lb.	500

Average Formation Tops

Formation—	Drilling depth (ft.)
Belly River	3,100
Cardium	4,350

PEMBINA FIELD
Alberta, Canada

Pay zone Cardium
TD (avg.) 5,300 ft.

Cost Averages, Per Ft. or Day

Footage price	$4.50
Day-work rate with drill pipe	$975.00
Day-work rate without drill pipe	$900.00

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day-work rate	15
Total days (spud to rig release)	18
Total number of bits	15

Equipment

Fuel: Diesel (average 400 gal. per day).
Water supply: Local.
Nearest supply center: Drayton Valley.
Terrain and roads: Rolling bush and muskeg; roads are constructed (gravel).

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	600	525
Oil string	5½	5,300	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Belly River	3,100
Basal Belly River	3,850
Lea Park	3,900
First White Specks	4,500
Cardium zone	4,900
Cardium	5,100

RED EARTH FIELD
Alberta, Canada

Pay zone Granite Wash
TD (avg.) 4,800 ft.

Normal Rig-Time Distribution

Per cent on footage rate	all day work to date
Per cent on day-work rate	100
Total days (spud to rig release)	35
Total number of bits	25

Equipment

Fuel: Diesel.
Water supply: Red Earth Creek.
Nearest supply center: Peace River.
Terrain and roads: Bush, muskeg, dry weather earthen roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	450
Oil string	5½	4,800	1,200 cu. ft.

Remarks: Production casing cemented to 1,100 ft., about 300 ft. above Wabiskaw.

Typical Mud Program

Material—	Amount
Gel, sacks	240
Quebracho, lb.	1,200
Plaster, lb.	1,500
Preservative, lb.	600
Sawdust and lost-circulation material	Varies from hole to hole
Caustic, lb.	700
Starch, lb.	7,000
Crude oil, bbl.	4,000

Average Formation Tops

Formation—	Drilling depth (ft.)
Devonian	1,500
Nisku	2,300
Slave Point	4,500
Granite	4,800

SAVANNA CREEK FIELD
Alberta, Canada

Pay zone Rundle 7,210-8,062 ft; Banff, 8,062-8,155 ft.
TD (avg.) 9,000 ft.

Cost Averages, Per Ft. or Day

Day-work rate with drill pipe	$1,080
Day-work rate without drill pipe	960

Normal Rig-Time Distribution

Per cent on day-work rate	100
Total days (spud to rig release)	265
Total number of bits	255

Equipment

Fuel: Propane.
Water supply: Surface.
Nearest supply center: Calgary.
Terrain and roads: Mountainous.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	880	400
Oil string	7	9,100	400 cement, 300 sacks diesel "D"

Typical Mud Program

Material—	Amount
Caustic, lb.	10,000
Quebracho, lb.	15,000
Driscose, lb.	10,000
Oil, bbl.	500

Average Formation Tops

Formation—	Drilling depth (ft.)
Blairmore	1,038

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Plastic Applicators, Inc.

TUBULAR GOODS INSPECTION SERVICES
BAKED-ON PLASTIC COATINGS

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CAPACITY—Three Plasticap plants—one of them advantageously near your location — have an aggregate capacity in excess of all other baked-on coatings suppliers.

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Dalhousie	3,479
Kootenay	5,227
Fernie	5,621
Rundle	6,401
Banff	8,062

Remarks: Normal fresh water mud treated with caustic and quebracho. Water loss control with Driscose No. 5—8 per cent oil emulsion, native weight. Lost-circulation material as needed.

FORT ST. JOHN FIELD
British Columbia, Canada

Pay zone	Triassic "C"
TD (avg.)	4,450 ft.

Cost Averages, Per Ft. or Day

Footage price	$8.50 to 4,000 ft.; $15 to TD
Day-work rate with drill pipe, per hour	$40
Day-work rate without drill pipe, per hour	$35

Normal Rig-Time Distribution

Per cent on footage rate	75
Per cent on day-work rate	25
Total days (spud to rig release)	30

Equipment

Fuel: Diesel.
Water supply: Good.
Nearest supply center: Fort St. John.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	600	380
Oil string	7	4,450	450

Average Formation Tops

Formation—	Drilling depth (ft.)
Cadomin	3,100
Triassic "A"	3,800
Triassic "B"	3,850
Triassic "C"	4,400

NORTH VIRDEN FIELD
Manitoba, Canada

Pay zone	Mississippian—Lodgepole
TD (avg.)	2,040 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe, per hour	$32.00
Day-work rate without drill pipe, per hour	$30.00

Normal Rig-Time Distribution

Per cent on footage rate	64
Per cent on day-work rate	36
Total days (spud to rig release)	6-11
Total number of bits	3-7

Equipment

Fuel: Diesel.
Water supply: Trucked.
Nearest supply center: Virden, Man.
Terrain and roads: Good; rolling terrain.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	500	275
Oil string	5½	2,040	160

Typical Mud Program

Material—	Amount
Gel, lb.	4,900
Starch, lb.	1,450
Preservative, lb.	300
Plaster, lb.	1,000
S.A.P.P., lb.	200

Average Formation Tops

Formation—	Drilling depth (ft.)
Viking	1,190
Mississippian	1,895
Crinoidal	1,965
Oolitic	1,995
Cherty	2,025

VIRDEN-ROSELEA FIELD
Manitoba, Canada

Pay zone	Mississippian
TD (avg.)	2,100 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.75
Day-work rate with drill pipe	$768.00
Day-work rate without drill pipe	$720.00

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day-work rate	15
Total days (spud to rig release)	11
Total number of bits	6

Equipment

Fuel: Diesel.
Water supply: Ditches, ponds.
Nearest supply center: Virden.
Terrain and roads: Flat; gravel.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	450	325
Oil string	5½	2,080	150

Typical Mud Program

Material—	Amount
Gel, sacks	30
Starch, lb.	1,750
Preservative, lb.	200
Plaster of paris, lb.	1,150
Salt, lb.	5,000

Remarks: If required, an average of 150 lb. S.A.P.P. and 250 lb. bicarbonate of soda are used per well.

Average Formation Tops

Formation—	Drilling depth (ft.)
Lodgepole	1,965
Crinoidal	2,050
Oolitic zone	2,075
First Oolite	2,080

CARNDUFF FIELD
Saskatchewan, Canada

Pay zone	Mississippian-Charles
TD (avg.)	4,200 ft.

Normal Rig-Time Distribution

Per cent on footage rate	73
Per cent on day-work rate	27
Total days (spud to rig release)	16
Total number of bits	9

Equipment

Fuel: Diesel.
Water supply: Surface.
Nearest supply center: Estevan.
Terrain and roads: Farming land; dirt roads.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	550	300
Oil string	4½	4,155	250

Typical Mud Program

Material—	Amount
Plaster, lb.	1,500
Starch, lb.	2,200
Preservative, lb.	300
Salt, lb.	2,500

Average Formation Tops

Formation—	Drilling depth (ft.)
Second White Specks	2,400
Jurassic	3,240
Mississippian-Charles	4,155

HASTINGS FIELD
Saskatchewan, Canada

Pay zone	Mississippian limestone
TD (avg.)	3,900 ft.

Cost Averages, Per Ft. or Day

Footage price	$4
Day-work rate with drill pipe	$900
Day-work rate without drill pipe	$750

Normal Rig-Time Distribution

Per cent on footage rate	80
Per cent on day-work rate	20
Total days (spud to rig release)	12
Total number of bits	10

Equipment

Fuel: Diesel.
Water supply: Surface water.
Nearest supply center: Carnduff.
Terrain and roads: Rolling, dirt, and gravel.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	8⅝	500	325
Oil string	5½	TD	225 and 4% gel

Typical Mud Program

Material—	Amount
Plaster, lb.	1,500-2,000
Starch, lb.	3,000-3,500
Preservative, lb.	250-350

Average Formation Tops

Formation—	Drilling depth (ft.)
Blairmore	2,700
Jurassic	3,000
Anhydrite	3,600
Mississippian	3,850

Remarks: Operators use water to 3,000 ft. and convert to a gypsum-base mud at 3,500 ft.

STEELMAN-HIRSCH FIELD
Saskatchewan, Canada

Pay zone	Mission Charles
TD (avg.)	4,800 ft.

Cost Averages, Per Ft. or Day

Footage price	$3.50 to $4.00
Day-work rate with drill pipe	$816.00
Day-work rate without drill pipe	$768.00

Normal Rig-Time Distribution

Per cent on footage rate	85
Per cent on day work rate	15
Total days (spud to rig release)	14-16
Total number of bits	10

Equipment

Fuel: Diesel.
Water supply: Hauled by trucks.
Nearest supply center: Estevan.

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	9⅝	600	275
Oil string	5½	4,800	350

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Old pipeline converted from crude to products service. Cost of chemicals, scrapers, hauling of diesel fuel, and contamination totaled $9,060.

By Harold Slief
Continental Pipe Line Co.

CONTINENTAL Pipe Line Co. has completed the conversion of approximately 100 miles of 6-in. pipeline between Wichita Falls and Saginaw, Tex., from crude to products service. The line was laid in 1918 using threaded and collared pipe and had had no major reconditioning such as welding of the threaded joints.

The methods used in this conversion proved highly satisfactory from the standpoint of efficiency of the cleaning operation. They also proved to be more economical than previous methods of cleaning crude lines used by our company. Many crude lines have been cleaned and placed into products service. Some companies have used a solvent, such as diesel fuel, running a great number of scrapers in the stream, while others have used a commercial solvent or detergent.

These methods do only a partial job in several instances; therefore, a complete review of the experience of cleaning crude pipelines was made prior to beginning any work on this project. It was indicated that there were four problems involved in efficiently cleaning a crude pipeline for products service. These were as follows:

1. Removal of oily substances other than paraffin where these form a coating on the top of the paraffin.
2. Removal of paraffin.
3. Removal of rust and mill scale.
4. Removal of sulfide imbedded in the pipe pores which will go into solution and contaminate products requiring low sulfide content.

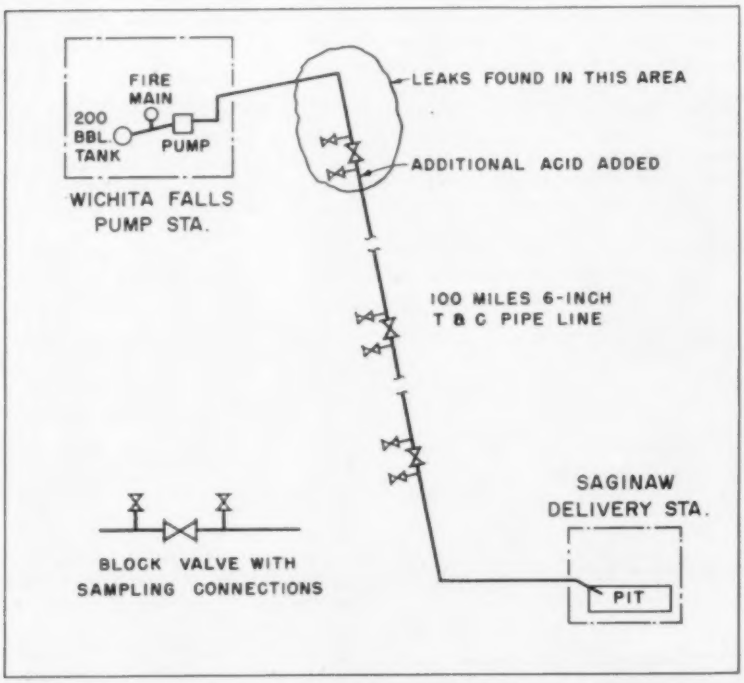


DIAGRAM of facilities for chemical treatment of 100-mile, 6-in. line during preparations for conversion from crude oil to product service.

Cleaning tests . . . It is recognized that all four of these may not be a problem in a particular line; for example, paraffin may not be present. Sections of pipe were cut from the above line and taken to the laboratory at Ponca City, Okla., for testing. Tests were designed to determine the best means of accomplishing the four types of cleaning listed above.

The experience of another pipeline company indicated that sodium metasilicate was a satisfactory solvent for oily substances other than paraffin and that the sodium metasilicate was more effective when combined with a wetting agent. Tests were made with various wetting agents combined with sodium metasilicate. It was determined that a solution of 5 per cent sodium metasilicate and 0.25 per cent of a commercial wetting agent gave the most satisfactory results.

Tests were made to find the best solvent for the paraffin. Diesel fuel, kerosine, and gas-oil samples from the Wichita Falls area were obtained and tests made on the quantity of paraffin that each would remove. The results indicated that the diesel fuel was slightly better than the other two and 1,130 bbl. would remove the 100,000 lb. of paraffin estimated to be present in the line.

The samples of pipe were tested in hydrochloric acid to determine the reaction time required. Tests indicated that 15 per cent hydrochloric acid would remove all scale, rust, and sulfides in 30 minutes. Inhibited acid was used since the reaction on oxides and sulfides is not affected by the inhibitor, but the reaction on bare steel is greatly reduced.

Cleaning procedure . . . After comparing the laboratory results, information received from other pipeline companies and oil-field service companies, the following cleaning procedure was developed for the 100-mile, 6-in. line:

Pumping Rate—200 Bbl. Per Hour

Cost of chemicals, scrapers, hauling, loss, etc. was $9,060

1. Starting with a packed line pump 200 bbl. 5 per cent (3,500 lb.) sodium metasilicate solution with 0.25 per cent (175 lb.) Warcosol 60-T into line with two scrapers spaced 100 bbl. apart (to remove the oily substances other than paraffin).

2. Pump 2,000 bbl. of diesel oil with 10 scrapers spaced 200 bbl. apart (to remove paraffin).

3. Repeat Step 1 to remove oily film left by diesel fuel and any other oil deposits still in pipe.

4. Pump 22 bbl. of water with a scraper—to clean line of basic silicate that would neutralize acid and to act as buffer between basic silicate and acid.

5. Pump 200 bbl. of 15 per cent inhibited hydrochloric acid with three scrapers, spaced approximately 70 bbl. apart.

6. Pump 200 bbl. of water with one scraper.

7. Repeat Step 5.

8. Repeat Step 6.

9. Pump 200 bbl. of soda-ash solution (1,600 lb. of soda ash) to neutralize any acid left in the line.

10. Displace line with water that has a pH of 11 (7,000 lb. sodium nitrite and 50 lb. sodium hydroxide). This is to keep line from rusting until gasoline is put into the line.

Cleaning operation . . . A scraper was used as a plug between all batches to prevent commingling. The scrapers put in the acid were of the nonexpandable type. The spring steel used in the expandable-type scrapers breaks when run in the acid.

The pumping rate was set at 200 bbl. per hour in order to get good scraping action from the scrapers. A faster rate was not used due to the contact time required for the sodium metasilicate. The laboratory tests indicated 1 hour contact time for the sodium metasilicate would be desirable. Therefore, if a faster pumping rate were used, a larger amount of sodium metasilicate would be required.

Two thousand barrels of diesel fuel was used instead of the 1,130 bbl. indicated by the tests in order to be on the safe side.

Two hours' contact time for the acid was used instead of the ½ hour indicated by laboratory tests. This was to allow for weakening of the acid solution due to chemical reaction with the mill scale and commingling with water buffers in the pipeline and to allow for temperature difference between laboratory and the ground which would slow down the reaction. Here again, if a higher pumping rate were used, a larger quantity of acid would be required.

At Wichita Falls, water was readily available from the fire main at the crude pump station. A 200-bbl. tank was moved in to mix the sodium metasilicate and sodium nitrite solutions. The acid and soda-ash solutions were furnished and pumped by an oil-field service company. The sodium nitrite was mixed in 200 bbl. of water. It was injected into the line at the rate of 2 bbl. per hour as the 19,500 bbl. of water required to displace the cleaning solutions was being pumped.

Results . . . The acid was started into the line at approximately 2 p.m. At 7:30 a.m. the next day the line flyer reported nine leaks. During the day nine additional leaks were found by line walkers. All these leaks were repaired as rapidly as possible in order to maintain the pumping rate and keep the chemicals moving. The next morning five leaks were found. These 23 leaks occurred in the first 30 miles of line. This section of line had a very high leak record and approximately 7,000 ft. of pipe had been replaced in order to maintain 1,000-psi. test pressure before the cleaning was started.

Samples of acid were caught and tested at the next block valve downstream from the leaks. It was determined that the combination of use and loss through leaks had reduced the acid "slug" to 50 bbl. of 5 per cent acid. The line was cut just downstream from the first block valve and 200 bbl. of 15 per cent acid and 100 bbl. of soda ash pumped into the line at this point. Scrapers were put in to act as buffers. This acid was followed day and night by line walkers to repair any further leaks. No additional leaks occurred.

At Saginaw a pit was available to catch the sodium metasilicate, acid, and soda-ash solutions until they could be checked for acid content. Approximately 5 tons of crusher limestone was placed in the pit to neutralize any acid that was not neutralized by reaction with mill scale and rust and the soda-ash solution.

"Weren't you the guy I sent out here, in the first place, to repair this leak?"

The contaminated diesel fuel was sold to a refinery for reprocessing. The diesel fuel was loaded directly from the pipeline into transport trucks at Saginaw and hauled away.

A piece of pipe was cut from the line after it was cleaned to visually check the results. The section cut out had a threaded and collar joint in it. The pipe was cleaned of all deposits and was bright except for the bottom of the threads in the joint. There was some fine sand with paraffin in the threads on the bottom of the pipe that had not been removed. A thin film of rust formed on the pipe immediately after it was exposed to the air.

When gasoline was pumped through the line only some 300 bbl. of discolored gasoline was received at Saginaw. This discoloration was due to rust that had formed in the pipe where it had been cut and drained to replace the bad pipe in the area of the leaks.

The cost of chemicals, scrapers, hauling of diesel fuel, and loss taken on contaminated diesel fuel was $9,060.

Conclusion

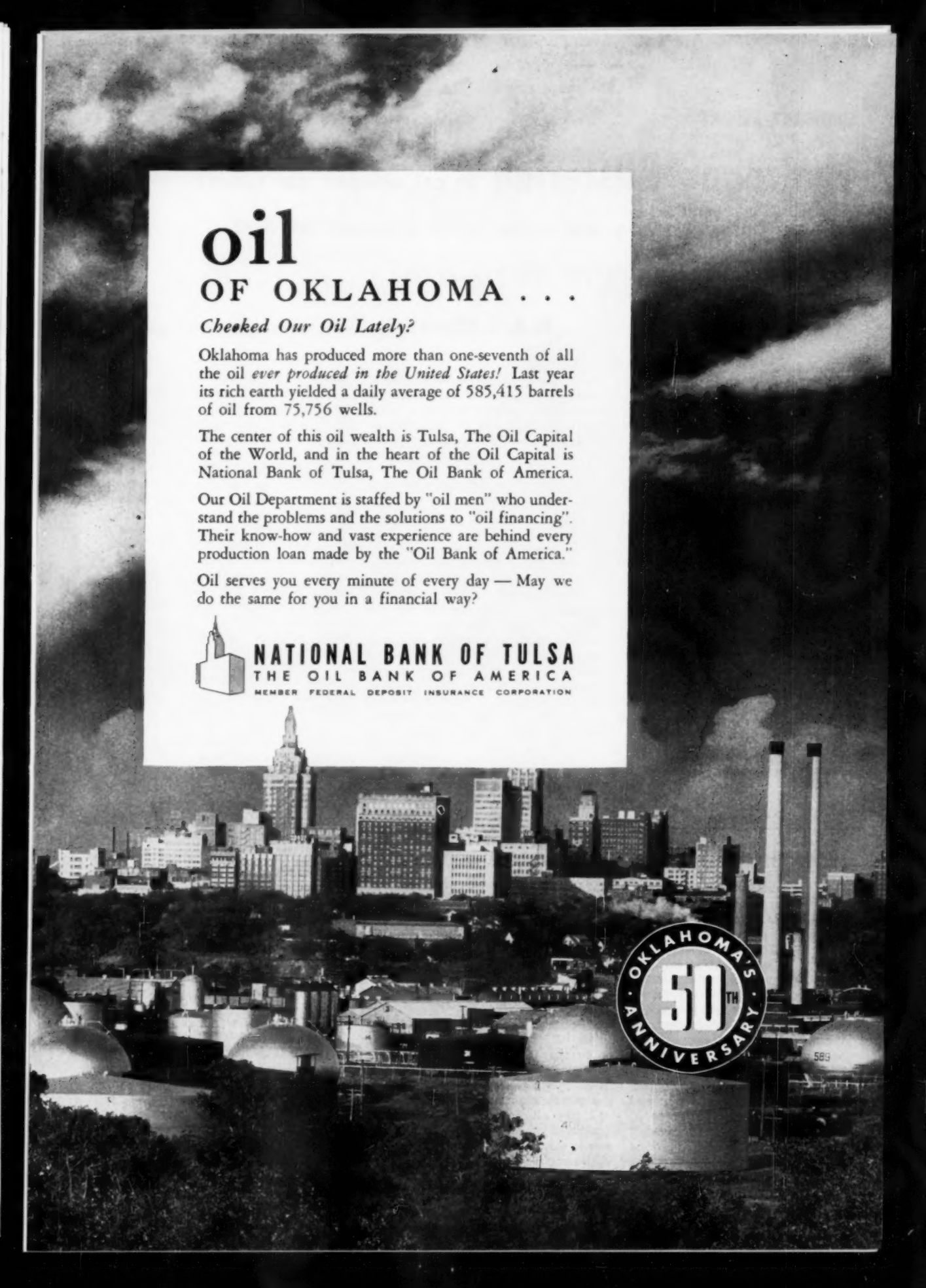
There are three factors to be considered to determine the quantities of the cleaning solutions required:

1. Reaction time—the time that is required for a solution to be in contact with the pipe.

2. Carrying capacity of cleaning agent—amount of deposit that can be dissolved or kept in suspension by cleaning agent.

3. Pumping rate—rate required to move the scrapers fast enough to give a good scouring to pipe.

It is necessary that these three factors be determined for a given pipeline-cleaning job prior to beginning the work. It is felt that laboratory tests were borne out by the field application on this job. The methods outlined are believed to be the most economical for efficient elimination of the four most common product contaminants found in used crude systems. The method is also adaptable if three or fewer of these contaminants are encountered by merely eliminating steps in the procedure. **End.**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SUMMARY REPORT

Hydrogen Blistering in cat cracker gas plants can be combated by improved feed preparation and better control of catalyst quality

By R. T. Effinger

THE environmental conditions which favor hydrogen attack in catalytic cracker gas plants are now well known. The conditions of inspection to detect hydrogen attack and the use of probes, painted-can tests, or spot chemical tests provide ways by which a refiner can determine whether hydrogen attack is occurring.

The conditions surrounding the catalytic cracking process which favor the formation of compounds or contaminents which promote hydrogen blistering are not as well understood. Nevertheless, there are indications which suggest that improved feed preparation and improved control of catalyst quality may reduce the probability that this type of attack will occur.

Areas of attack . . . The probability of hydrogen attack occurring in the gas plants associated with fluid catalytic cracking units was brought out by a questionnaire survey Hydrogen attack occurred in 26 out of 38 fluid catalyst plants reporting data. Equipment such as condensers, coolers, accumulators, and absorption towers in the high-pressure gas stabilizer were most vulnerable to hydrogen attack.

The environments where hydrogen attack occurred were limited to those environments where a water phase occurred, where sulfides were present, and in environments having either high or low pH values. In many instances, the attack occurred in high pH or alkaline environments which were contaminated with cyanides, although it has been established definitely that cyanides are not always necessary for this type of attack to occur. In general, the more severe instances of hydrogen attack followed the lighter hydrocarbon fraction through the plants.

Process conditions . . . Efforts were made in the survey to establish the catalytic cracking conditions and feed-preparation conditions which might throw a light on the possibilities for controlling hydrogen attack through control of the feed preparation or catalytic cracking process. This survey brought out the fact that the nitrogen content of the feed stock had an influence on the amount of cyanides produced during the cracking process. High nitrogen content in the feed correlated with the probability of hydrogen attack occurring in the gas plants following catalytic cracking.

Other correlations with feed-stock characteristics and cracking conditions were not conclusive. However, it is suspected from these data and from other experiences, that the catalyst quality may be an influencing factor. For example, some data appear to indicate that natural catalyst is associated with more active hydrogen attack in the gas plants following catalytic crackers.

Author is with Shell Oil Co., Houston. This article represents the summary report of the panel on hydrogen blistering, Subcommittee on Corrosion, Division of Refining, of the A.P.I.

How this study was conducted . . .

The low-temperature hydrogen attack occurring as the result of corrosion has been the topic of several technical papers published since 1948. Bartz and Rawlins[1 2 3] published a series of papers in 1948 and 1949 describing the damage which occurred to refinery vessels as a result of hydrogen attack. Effinger, Renquist, Wachter, and Wilson[4] published a paper in 1951 covering an industrywide survey of hydrogen attack occurring in catalytic cracking gas plants. Bonner, Burnham, Conradi, Skei, and Wachter[5 6] published a series of papers in 1953 to 1955 covering research on the corrosion process responsible for hydrogen attack and describing the development of air injection and other inhibitors from mitigating this type of attack. Neumaier and Schillmoller[7] published a paper in 1955 describing the application of control techniques to the problem of hydrogen attack occurring in a catalytic cracking gas plant.

In 1952 the Subcommittee on Corrosion, of the Division of Refining, A.P.I., instigated a panel on hydrogen blistering. This panel has reviewed the previously published literature and has surveyed the petroleum industry by means of a questionnaire to establish those conditions under which hydrogen attack was occurring, and to gain information on the operating variables in hydrogen attack.

Nature of Hydrogen Attack

When a piece of steel suffers a hydrogen attack, it may blister, become fissured with very small microcracks which can grow to dangerous proportions, or it may become embrittled so that ductibility is lost.[1 4 5 6] The formation of hydrogen blisters in the steel may be the first indication apparent to an inspector that hydrogen attack is occurring. It is certainly the most startling evidence of hydrogen attack. These blisters appear as swellings under the surface of the steel.

The size of a blister may be anywhere from a few millimeters in diameter to several feet in diameter. The size is related to the size of the sites of impurities, discontinuities, or laminations within the steel.

Rimmed steel is more subject to large blisters than is killed steel. This is due to the greater probability for slag inclusions, phosphide stringers, and minor laminations in rimmed steel as compared to the killed steels. Hy-

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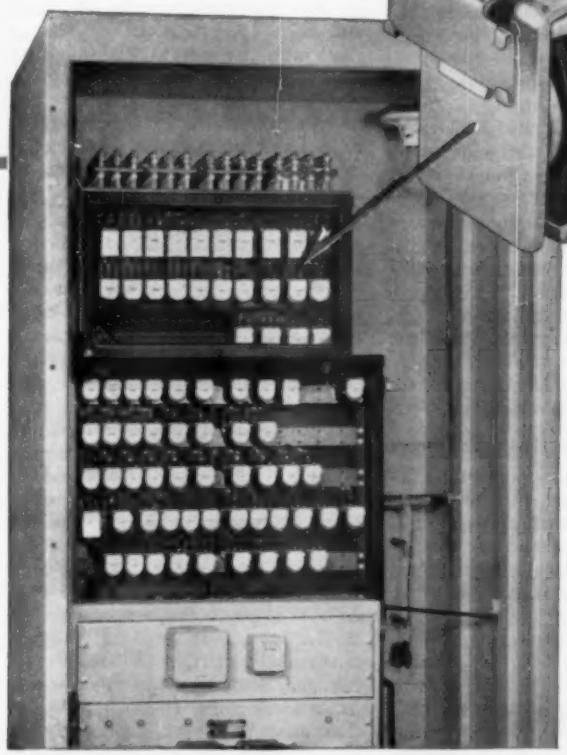

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drogen blisters form at these internal discontinuities. Blisters may form either on the inside surface of a pressure vessel subjected to hydrogen attack or upon the outside surface of the vessel. When the discontinuity, serving as the site for hydrogen accumulation, occurs closer to the inside of the vessel, hydrogen blisters will form at this point and bulge the steel layer over the inclusion inward.

The steel between the inner surface of the vessel and the blister must be loaded with hydrogen, and thus it will be in a brittle condition. The deformation of the steel during the formation of a blister places this layer of steel under a high stress, and it is often observed that blisters which form on the inside surface of a pressure vessel are cracked across the crown of the bilster.

It is unusual to find blisters which are formed on the external surface of a vessel to be cracked across the crown of the swollen area.

Internal stresses . . . When hydrogen penetration occurs in a clean killed steel or in a rimmed steel in a highly stressed area, small microfissures and cracks may occur on the surface of the steel. The hydrogen passing through the steel creates tremendous stresses in the steel, and it has been visualized that these stresses reach a point where the internal forces within the crystals of the metal literally tear the metal apart. This results in a fine pattern of microfissures and hairline cracks.

This type of damage is particularly insidious in that it normally occurs perpendicular to the lines of highest static stress on the steel, and thereby creates a maximum weakening effect. There have been a few instances where pressure vessels have failed as a result of this fissuring. Such cracks are likely to be concentrated in the highly stressed areas of heads and other discontinuities in a pressure vessel.

The visual detection of fissures and small hairline cracks is particularly difficult. The inside surface of such pressure vessels are usually corroded so that the surface is roughened. The pattern of fissures and cracks is not readily apparent by a normal visual examination. These cracks and fissures are quite easily revealed by magnetic particle inspection. They may also be revealed by etching the surface with hydrochloric acid.

It was suggested at one time that killed steels be used in the construction of pressure vessels to minimize the possibility of hydrogen blistering. Although the probability of hydrogen blisters being formed in killed steel is much less than the probability of their formation in rimmed steel, the occurrence of cracks and fissures may be less desirable than the occurrence of blisters. Blisters may be observed and warn the inspector that hydrogen attack is occurring. Hairline cracks and fissures are difficult to detect.

Steel embrittled . . . The third way in which hydrogen attack may be revealed is by embrittlement of steel. It often occurs that heat exchangers subjected to hydrogen attack are found with cracked bolts in the floating head cover. These bolts may be subjected to the hydrogen attack as the result of corrosion occurring on the shell side of the tube bundle. The bolts will be stressed during tightening, and subsequent permeation with hydrogen will cause them to have insufficient ductility to withstand the expansion and contraction stresses to which they are subjected.

Furthermore, these bolts are made usually from a tempered alloy steel. Such steels are particularly subject to embrittlement when permeated by hydrogen. Twelve per cent chronium steel commonly used in valve parts, such as valve seats and disks, often is embrittled by hydrogen. Likewise, spring-steel feather valves in compressors may be embrittled and springs of relief valves are often found broken due to this cause.

Where any of these symptoms are experienced—blisters, fissures, or embrittlement—it is warning that hydrogen penetration is occurring. The occurrence of blisters, fissures, or embrittlement in any system where the environment conditions may be favorable to hydrogen attack should be cause for further investigation.

Conditions Favoring Hydrogen Attack

The following environmental conditions normally occur in those areas where hydrogen attack of steel refinery equipment has occurred:

1. There must be at least a small, but significant rate of corrosion. Many severe cases of hydrogen attack have been observed to occur at only moderate rates of corrosion (1-10 mils per year corrosion rate).

2. Severe hydrogen attack has been observed to occur both fairly strong acidic and fairly strong alkyline environments. The corrosion rates is normally too low to produce damaging quantities of hydrogen in the pH range of 7.0 to 7.5.

3. In most refinery environments where severe hydrogen attack has been observed, there is an appreciable quantity of hydrogen sulfide present. The rate of attack occurring in acidic - aqueous - sulfide environments will normally increase as the pH of the aqueous phase is lowered. At pH ranges below 6.5, the rate of attack may be severe.

4. The rate of attack in alkaline solutions contaminated with sulfide is promoted by trace amounts of cyanides or other salts which promote corrosion in an alkyline environment.[4 5]

5. Corrosion inhibitors occurring either naturally in the process stream or added deliberately can reduce the rate of attack to levels where hydrogen damage does not occur. In alkaline environments, the presence of oxygen or other oxidizing agents may act effectively as an inhibitor. The inhibiting effect of oxidizing environments has been shown to be related to the formation of a polysulfide film upon the metal surface.[5]

6. The promoting effect of cyanides on the corrosion rate and resultant hydrogen attack occurring in an alkaline environment has been shown to be related to the formation of iron ferrocyanide upon the metal surface. This reaction provides a mechanism by which corrosion may continue in an alkaline environment. Any mechanism which removes such promoters from the corrosive environment has been found to be effective in reducing the rate of hydrogen attack.

The use of air as an inhibitor in such environments is partially effective as it provides a mechanism by which cyanide ions may be converted to thiocyanate. In dilute solutions thiocyanate is not a promoter of corrosion. The additional effect of air is to promote the formation of polysulfide on the metal surface to provide a true inhibitor. The quantity of air injected to produce this desirable effect is normally quite small and the techniques by which air may be effectively reacted with the environmental corrosive contaminants has been well described by Bonner et al in their papers.[5 6]

7. The production of cyanides in catalytic cracking gas plants is undoubtedly related to the quantity of nitrogen compounds in the feed to catalytic cracking. It has been shown that deep flashing of catalytic feed stocks and mechanical entrainment of heavy ends may drastically increase the quantity of nitrogen present in the feed.[4]

The cracking conditions favoring the formation of cyanides is not well understood, although some trials indicate that a higher reaction temperature results in the formation of more cyanides than a lower reaction temperature. Also it is suspected that nat-

ural catalyst or contaminated synthetic catalyst may produce more cyanides than uncontaminated synthetic catalysts.

A refiner experiencing hydrogen damage would do well to critically analyze his feed preparation unit with the aim of minimizing mechanical carryover of heavy ends which are normally rich in nitrogen compounds.

Mitigating Hydrogen Attack

The environmental factors which influence hydrogen attack are complex. The experience on some plants seemed to indicate that maintenance of ideal feed-stock conditions and regulations of the cracking severity may have a marked effect on the over-all probability that hydrogen attack will occur. In all catalytic cracking gas plants, environmental conditions are present which favor hydrogen attack. These are the locations where hydrogen sulfide and water can occur. These locations should be suspect.

An inspection of the equipment and the use of hydrogen-detecting devices such as probes or painted-can tests are recommended. Where hydrogen attack does occur, the refiner has at his command several means for studying the environmental conditions and several means for mitigating this attack. The use of hydrogen probes as described in the literature[4] provides a useful tool for detecting those environments where hydrogen attack occurs. Painted-can tests[5] will indicate the environments favoring attack. Also, spot chemical tests will indicate environments suspect of causing hydrogen attack.[5]

The use of protective linings, water injection for removal of or dilution of the corrosive, and the use of inhibitors are means available to the refiner to combat this type of corrosive attack.

Liners . . . Gunited cement liners, austenitic stainless-steel liners, Monel metal liners, and organic protective coatings have all been used to protect the surface of steel against the corrosion resulting in hydrogen attack. All of these protective liners have been effective.

Ordinary carbon-steel liners also are effective. Steel liners may blister badly, but if the enclosed space between the liner and the shell is vented by means of a small hole in the liner, it is seldom that serious corrosion occurs behind the liner.

Gunite, sand, and cement liners are effective in alkaline environments although they may be deteriorated by environments which are strongly acidic.

Epoxy, phenolic, and vinyl organic coatings have been used with varying degrees of success. The serviceability of these coatings depends upon the adhesion obtained in the application process and the thickness and impermeability of the organic linings.

Stainless-steel clad or lined vessels have been used with a great deal of success in many environments suffering from hydrogen attack. The austenitic grades of stainless steel are necessary for this use since the ferritic grades (i.e. 12 per cent chromium) may become severely cracked after only short exposure to these types of corrosive environments.

Linings are less practical when the attack occurs in piping, condenser tubes, etc. In these instances, it may be most profitable to so modify the corrosive environment that the attack does not occur.

Modification of environment . . . The corrosive environment may be modified by water washing, inhibition, or by dehydration. Since a water phase is necessary for the corrosive attack to occur, dehydration at the process streams will effectively reduce the occurrence of hydrogen attack. Complete dehydration may be only partially effective since subsequent entry of water into the system will completely nullify the effect of dehydration.

The use of dehydration has been limited therefore to only a few minor applications. On the other hand, if the process streams are completely freed of hydrogen sulfide, the likelihood of hydrogen penetration is small. However, the complete removal of hydrogen sulfide early in the refining process may not be economical. This leaves the alternative of modifying the process stream by water washing or the addition of inhibtors.

To water wash a large stream of refinery gas requires copious amounts of water. The disposal or reclamation of this water may present a serious operating problem. Where the alkalinity occurs from ammonia, water washing can effectively remove the greater quantity of this ammonia and thus reduce the pH of the aqueous phases close to neuatral. Under these conditions, hydrogen attack is less likely to occur than under the highly alkaline conditions where all the ammonia is left in the process stream.

Control of the pH within the range of 7 to 7.5 normally is safe. It has further been observed that the water which is used for washing the refinery stream may often contain dissolved oxygen, and this may be equivalent to the injection of air into the refinery stream in that any cyanides which may be present will be oxidized to thiocyanate. Sufficient excess oxygen may be present to form a protective film of iron polysulfide on the metal surface.

The direct injection of air also may be effective in inhibiting the corrosion causing hydrogen attack. Air has the advantage over solid water-soluble inhibitors in that it is carried along with the lighter hydrocarbon fractions and may react in situ with the sulfide present in the vapor spaces to form a protective film of iron polysulfide on the vessel wall. However, the efficiency of this reaction may be poor, with only 10 to 25 per cent of the air entering the process actually reacting with either cyanides or sulfides in the system.

A somewhat more efficient scheme has beeen proposed by Bonner[5 6] which involves the recirculation of air-saturated water in the system. This reduces both the quantity of water needed and provides the oxidizing agent in an already dissolved form which quickly reacts with the cyanides present. Also some oxygen will be extracted from the water into the hydrocarbon stream where it functions effectively as an inhibitor further downstream in the process.

The use of air in a low pH system is dangerous in that the air will promote a higher corrosion rate in an acidic system than would occur otherwise. It is therefore essential if oxidation by air or other oxidizing agents is resorted to that the system be maintained alkaline. This can be done either by the injection of ammonia or by so adjusting the water washing operations so that a pH in excess of 7.5 is maintained throughout the system.

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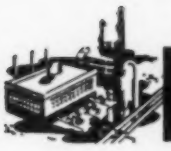
Part 5



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Laboratory Testing

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Making Specific Laboratory Tests

EQUIPMENT required for the A.S.T.M. distillation test consists of a heater, a flask to hold the sample to be tested, a thermometer mounted in the top of the flask, a condenser, and a cylinder marked off in 100 equal divisions to measure the sample and catch the condensate.

The test procedure is to distill the sample at a specified rate and to read the temperature of the vapor above the sample at the following specified intervals:

1. When the first drop leaves the condenser tube, this temperature reading is called the initial boiling point. (i.b.p.).
2. When each 10 per cent mark is reached by the condensate collected in the receiving cylinder.
3. When other specified points are required by specifications.
4. When the flask is dry the temperature climbs to a maximum then drops off suddenly, this maximum temperature is recorded as the final boiling point. (f.b.p.).

When the distillation is complete, the total oil condensed is the per cent recovered. The difference between this and the 100 mark is the per cent loss.

Flash point . . . The flash point is the temperature at which there is a sufficent concentration of vapor above the liquid sample to flash when a test flame is passed over the surface. This is an indication of the temperature at which the product becomes a fire hazard.

The test is a control test for operations to indicate the degree of fractionation and the completeness of steam stripping. Obviously too, it will readily show contamination of a light product in a heavy product.

This material taken from process-training-program manual, Baton Rouge, La., refinery of Esso-Standard Oil Co.

This test applies to naphthas, kerosine, distillates, lube oils, and fuel oils. There are two types of apparatus for determining flash points, the open-cup and the closed-cup testers.

The Cleveland open-cup tester uses an open cup with a thermometer mounted in the oil. The oil is heated slowly as a very small flame is passed across the sample. When the first flicker of flame is seen on the surface of the oil, the corresponding temperature of the oil is the flash point.

The Pensky-Martens and the tag closed-cup testers differ slightly. The Pensky-Martens test method provides for the stirring of the sample while testing. The tag-test method does not provide stirring but requires a water bath and limits the testing temperature to 175° F. Both types of closed-cup testers have a thermometer mounted in the oil and are equipped with a window that opens to allow a small flame to be lowered into the vapor space above the sample. The flame is tried repeatedly as the temperature on the oil is slowly raised. The temperature at which the first flash occurs is the flash point of the sample.

Fire point . . . The fire point of an oil is the temperature at which the oil will burn continuously when ignited with a flame. At temperatures between the flash point and the fire point the vapors will ignite but will not continue to burn.

The fire test is a continuation of the open-cup flash test. As the temperature is increased past the flash point, the flash will become stronger until the fire will burn continuously in the cup. The temperature of the sample at this point is the fire point.

Color . . . Colors have become important largely because the oil-buying public has demanded it. The color in lube oils, for example, does not affect the quality of the oil but the public expects a light oil to be light in color. The color test is one of our operation-control tests because color is a product specification and too this test proves useful in identifying leaking equipment or catching an operation that has developed trouble.

Color tests are required on practically all products from gasoline to lube oils.

To cover this range two instruments are used. The Saybolt instrument classifies light oil colors from water clear down to straw color; the Tag-Robinson colorimeter classifies heavier oil colors from straw color down to a dark lube oil. In principle the instruments are very much alike, that is, a column of oil is varied in depth to match a standard color disk while looking down through the oil and at the disk at the same time. The number system of identifying colors does not continue from one color method to the other.

Vapor pressure . . . This test indicates the extent light vapors will be released from a product at 100° F. This information is an indication of losses through evaporation, risk of handling, and tendency to vapor lock.

The Reid vapor-pressure test is used on gasoline and light naphthas.

The apparatus consists of a closed container fitted with a pressure gage. A measured quantity of the sample is sealed inside the container. The temperature of the apparatus is raised to 100° F. and when the pressure becomes constant the pressure reading is the vapor pressure.

AN IMPORTANT ANNOUNCEMENT

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American Cyanamid Explosives Now Serve You Nationwide and Market-Wide!

In a move to extend and broaden the range of our services to explosives users, American Cyanamid Company has purchased the plants, magazines and sales facilities of Illinois Powder Manufacturing Company.

Because of these expanded facilities, it is now possible for Cyanamid to serve you better...faster...with a wider range of dependable, *quality* explosives, electric blasting caps and blasting accessories.

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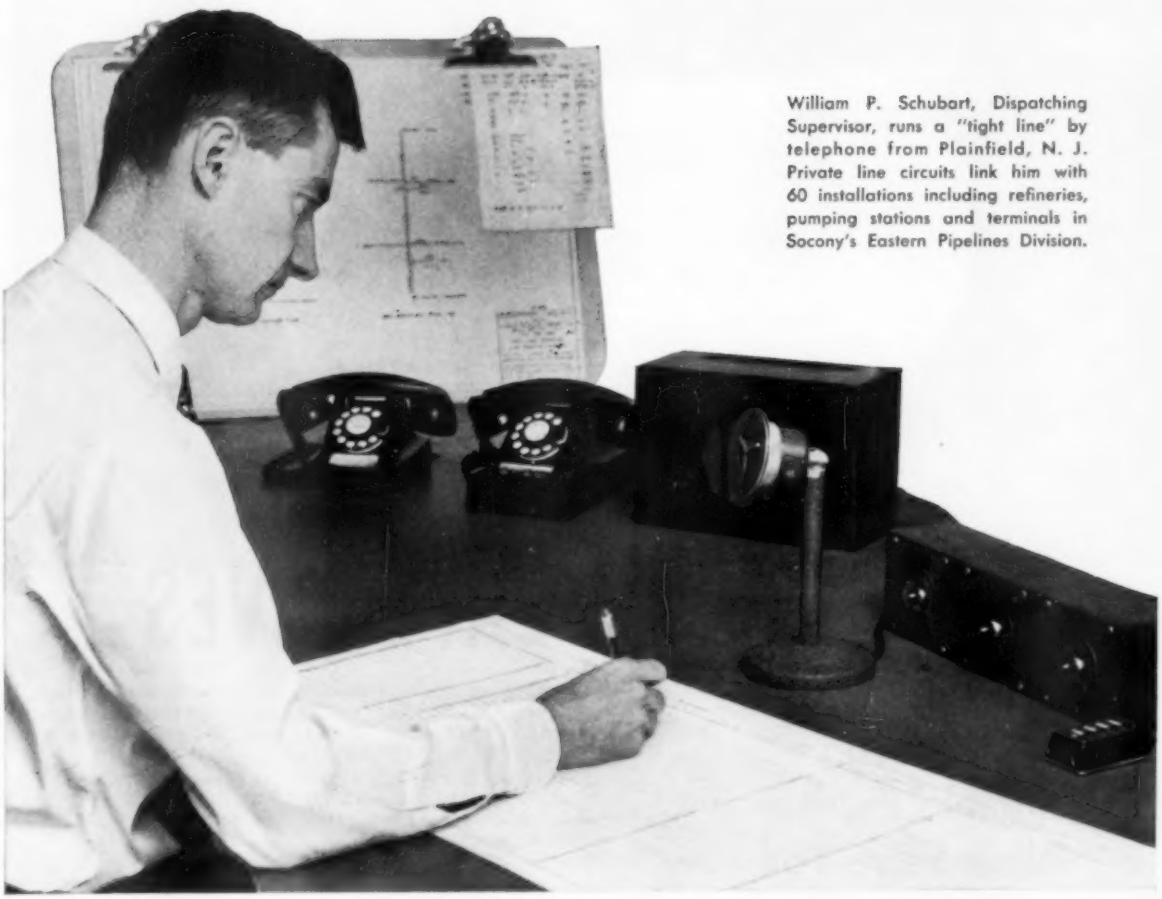

William P. Schubart, Dispatching Supervisor, runs a "tight line" by telephone from Plainfield, N. J. Private line circuits link him with 60 installations including refineries, pumping stations and terminals in Socony's Eastern Pipelines Division.

He's keeping track of 40 batches by private line telephone service

Using Bell System private line telephone service, the Plainfield, N.J., dispatcher of Socony Mobil Oil Company keeps multi-product traffic flowing through three different pipeline systems. Up to 40 batches of different products are en route at the same time.

The dispatcher relies on the telephone (1) to instruct gaugers at delivery points, (2) to keep all products moving at a proper rate, and (3) to verify the volume of each batch at check points in the line.

Socony Mobil has used Bell System communications for 26 years, has found them dependable and accurate . . . qualities that may well help your own operation. Just call your Bell Telephone Company business office. A representative will gladly study your needs. No obligation, of course.

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Pipeline Patrol

...Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

• **Belle Fourche Pipeline Co.**
Project: 30 miles of 6-in. from Donkey Creek pool to Fiddler Creek pool in northeastern Wyo. Will later build a line from Fiddler Creek to connect with Butte Pipe Line Co. near Osage, Wyo.
Status: Planned.

• **Cape Pipe Line Co.** (Sun Oil Co., Cities Service Co., Atlantic Refining Co.)
Project: Line from lower Delaware Bay to Philadelphia.
Status: Long range plans.
Completion: 1960.

• **Forest Pipeline Corp.**
Project: 35 miles of 8-in. from Grieve field, Wyoming, to Platte Pipe Line at Casper.
Status: Under way.
Completion: Fall 1957.

• **Four Corners Pipe Line Co.** (Shell, Standard of Calif., Continental, Gulf, Richfield, Superior)
Project: 635 miles of 16-in. from Aneth field in southern Utah to Los Angeles, 86 miles of 12-in. from New Mexico's Bisti field to Red Mesa station 35 miles southeast of Bluff, Utah, and 3 miles of 6, 8, 10-in. feeder lines from other fields in New Mexico and Utah. Will be operated by Shell Pipe Line.
Status: Under way.
Contractor: **A. P. Vaughn Construction Co.** and **Potashnick Construction Co.** have 170 miles of 16-in. from Aneth field to Cameron, Ariz., and 100 miles of 16-in. from Seligman to the Colorado River. **R. H. Fulton Construction Co.** has 98 miles of 16-in. from Cameron to Seligman, Ariz., and 217 miles of 16-in. from the Colorado River to Olive, Calif. **Pacific Pipeline Co.** has 46 miles of 16-in. from Olive to Los Angeles; **Standard Pipeline Contsruction Co.** has feeder lines.
Completion: January 1958.

• **Great Northern Railway Co.**
Project: 400 to 600 miles of 12 to 20-in. from Williston basin in Montana and North Dakota, to Clearbrook or St. Paul, Minn.
Status: Planned.
Contractor: **Pipe Line Technologists, Inc.** has completed feasibility study.

• **Interstate Oil Pipe Line Co.**
Project: 5 miles of 4-in. from South Bosco field, and 5 miles of various size from Church Point field, La., to present main line.
Status: Proposed.

• **Magnolia Pipe Line Co.**
Project: 24 miles of 20-in., 20 miles of 12-in., 83 miles of 16-in. from Corsicana to Baird, Tex.
Status: Under way.
Contractor: **H. B. Zachry Co.,** Ray Qualls, supt., office at Hico.
Completion: November 1, 1957.
Project: 120 miles of 16-in., 4 miles of 12-in. from Clyde to Midland, Tex.
Status: Under way.
Contractor: **O. R. Burden Construction Corp.**
Completion: December 31, 1957.

• **Muskegon Pipe Line Corp.** (Aurora Gasoline Co., Service Pipe Line Co.)
Project: 165 miles of 10-in. from Griffith, Ind., to Muskegon, Mich.
Status: Under way.
Contractor: **Midwestern Constructors, Inc.** has two spreads working: North end, W. T. Wilhite, supt., office at Coloma, Mich.; South end, office at Chesterton, Ind.
Completion: Late 1957.

• **Northwest Pipeline Corp.**
Project 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.
Status: Proposed.

• **Offshore Gathering Corp., Houston.**
Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)
Status: Proposed.

• **Oil Field Pipe Line, Inc.**
Project: 200 miles 8 and 12-in. line from near Elkhart, to Ellinwood, Kans.
Status: Proposed.

• **Salt Lake Pipe Line Co.**
Project: 93 miles of 10-in. loops from Rangely, Colo., to Salt Lake City.
Status: Under way.
Contractor: **Engineers Limited Pipeline Co.**
Completion: December 1, 1957.

• **Service Pipe Line Co.**
Project: 4 miles of 12-in. loop between Dyer and Griffith, Ind., and 8 miles of 24-in. loop in Will County, Ill.
Status: Under way.
Contractor: **O. R. Burden Construction Corp.**

• **Sinclair Pipeline Co.**
Project: 150 miles of 20-in. from Teague Tex., to Houston.
Status: Planned for 1958.
Completion: 1958.

• **Skelly Oil Co.**
Project: 38 miles of 8-in. extension of its gathering system into southern Kiowa County, Kansas.
Status: Under way.
Completion: Early fall 1957.
Project: 50 miles of 12-in. to replace partially looped 6, 8-in. line between Cunningham and Burton, Kans.
Status: To start as soon as pipe is received.
Completion: Late 1957.

• **Southern Kansas Pipeline, Inc.**
Project: 200 miles of 6 to 10-in. in Kans. from southwestern Meade County to 10 miles north of Arkansas City.
Status: Proposed. Request filed with Kansas Corporation Commission for permit.

• **Texas-New Mexico Pipe Line Co.** (Sinclair, Texas Co., Tidewater, Empire)
Project: 512 miles of 16-in. from southeast corner of Utah to Jal, N. M.
Status: Under way.
Contractor: **Four Way Co., Inc.,** has 150 miles from Aneth field southeast. **Panama, Inc.,** has remaining 362 miles.
Completion: 1958.

• **Texas Pipe Line Co.**
Project: 7 miles of 8-in. in West Cote Blanche Bay, La.
Status: Under way.
Contractor: **Houston Contracting Co.,** H. E. Murphy, supt., office at Franklin.

U.S. Products Pipelines

• **Alaska-Yukon Refiners & Distributors, Ltd.**
Project: Two lines: one 150 miles from

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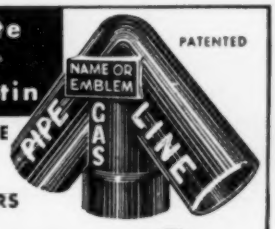

PIPELINE VENTS AND MARKERS

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ENGINEERS & SURVEYORS
OUACHITA BANK BLDG.
MONROE, LA.

SURVEYING & MAPPING

PIPE LINE SURVEYS

Pipeline Patrol

Haines to Haines Junction, Alaska, linking with government Canol line; another from Tok Junction, on Canol line, to Anchorage.
Status: Proposed.
Completion: 1959.

• **American Pipe Line Co.**
Project: Line from Gulf Coast to New York City. Has ODM approval to amortize 40 per cent of cost with fast writeoff.
Status: Proposed.

• **Buckeye Pipe Line Co.**
Project: Conversion of 32 miles of 8-in between Mantua and Youngstown, Ohio.
Status: Planned.
Contractor: Company will do own work
Completion: November 1957.
Project: 70 miles of 8-in. from Wayne to vicinity of Durand, Mich.
Status: Under way.
Completion: Early 1958.

• **Conn-Mass Pipe Line, Inc.**
Project: 62 miles of 8-in. and 7 miles of 6-in. from New Haven, Conn., to Springfield, Mass.
Status: Planned to begin in 1957.
Completion: April 1958.

• **El Paso Natural Gas Co.**
Project: 11 miles of 4-in. L.P.G. from Snyder Line to South Andrews Plant, Tex.
Status: Planned
Project: 240 miles of 6-in. from Odessa to El. Paso, Tex.
Status: Under way.
Contractor: McVean & Barlow, Inc., E. J. Miller, supt.
Completion: March 1, 1958.

• **Emerald Pipe Line Corp.**
Project: 120 miles of 6-in. from Sunray, Tex., to Tucumcari, N. M.
Status: Planned.
Completion: December 1, 1957.

• **Engineering Management, Inc.**
Project: 37 miles of 4, 6-in. L.P.G. line from Niland to El Centro, Calif.
Status: Under way.
Contractor: Hood Construction Co., C. L. Jernigan, supt., office at Brawley.
Completion: November 1957.

• **Everglades Pipe Line Co.**
Project: 60 miles of 10-in. from Port Everglades, Fla., to Miami's International Airport and terminals south.
Status: Under way.

• **Florida Pipeline & Storage Co.**
Project: 67 miles from Everglades, Fla., to Homestead Air Force Base south of Miami.
Status: Under way.
Contractor: Fish Service Corp.
Completion: December 1957.

• **Gillette Pipeline, Inc. and A. W. Hartwig, Inc.**
Project: A 103-mile line from Dead Horse Creek field to Casper, Wyo.
Status: Has applied for permit from Wyoming Public Service Commission.

• **Great Lakes Pipe Line Co.**
Project: 93 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.
Status: Under way.
Contractor: R. H. Fulton & Co. has the 8-in. Midwestern Contractors, Inc., has 20 miles of 12-in. in Chicago area and M-R Co. has completed 48 miles of 12-in. from Badger system east.
Completion: Late 1957.
Project: 15 miles of 6-in. from Lincoln Neb., to Lincoln air base.
Project: 140 miles of 8-in. from Minneapolis to Superior terminals.
Status: Under way.
Contractor: Laco Pipeline Contractors, Inc.
Project: 14 miles of 8-in. from Coffeyville to Independence, Kans., replacing 4-in. line.
Contractor: Jess Whitlow Pipe Line Service.
Project: 11 miles of 8-in. from 10 miles east of Donahue, Iowa, to terminals at Bettendorf, Iowa.
Contractor: R. T. Perry Pipe Line Construction.

• **Laurel Pipeline Co.** (Gulf Refining Co., Sinclair Pipe Line Co., The Texas Co.)
Project: 100 miles of 24-in. and 340 miles of line graduating down to 14-in. at the west terminus, from Philadelphia to Cleveland.
Status: To start early 1958.
Completion: 1958.

• **Leonard Refineries, Inc.**
Project: 43 miles of 6-in. from Alma to Lansing, Mich.
Status: Planned.
Completion: Late fall 1957.

• **Northwest Pipeline Corp.**
Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.
Status: Proposed.

• **Ohio Oil Co.**
Project: 350-miles of 12-in. from Wood River, and Robinson, Ill., to Chicago.
Status: Under way.
Contractor: Panama-Williams Corp. has 84 miles from Robinson to Champaign.
Completion: 1958.

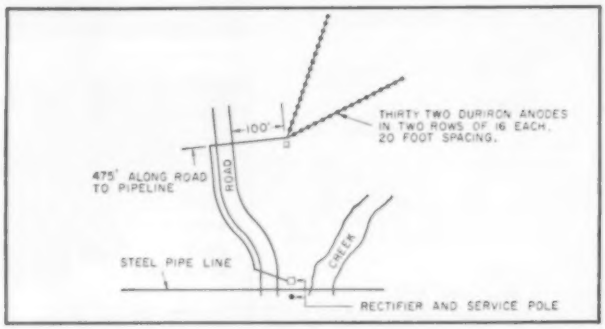
• **Salt Lake Pipe Line Co.**
Project: 80 miles of 8-in. loops from Adams to Ontario, Ore.
Status: Under way.
Contractor: Hallmac Construction Co.

• **Underground Storage & Exploration, Inc.**
Project: 393 miles of 12-in. L.P.G. line from Moundsville, W. Va., to Newark, N. J., plus 35 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.

32 DURIRON® ANODES

protect 11,000 feet of steel water line without backfill

The Problem: An isolated section of 11,000 feet of steel water line needed cathodic protection. Tests showed current requirements to be 40 amps., but replacement of adjacent wood stave lines called for extra capacity. Ground was a peat bog with water table standing at 6 inches below surface, making backfill methods impossible.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The Installation: 32 Duriron Anodes (2" x 60") were installed without backfill, by digging through the dry surface and then pushing anodes down until the tops were 3 feet below surface. Anodes were installed 20 feet apart, in two rows, with a calculated resistance of one ohm, based on previous experience with similar installations. While conventional backfill columns would have reduced the number of anodes necessary, the use of bare anodes constituted a major saving in cost.

The Performance: The anode bed is discharging 60 amps. at a terminal voltage of 59 volts. The entire line section is under protection, the minimum potential being 1.18 volts. This affords ample margin to handle prospective additions to the line. Agreement between actual and calculated anode resistance is quite close.

Action: For further information on this particular installation or for technical assistance on other Duriron impressed current anode installations, write:

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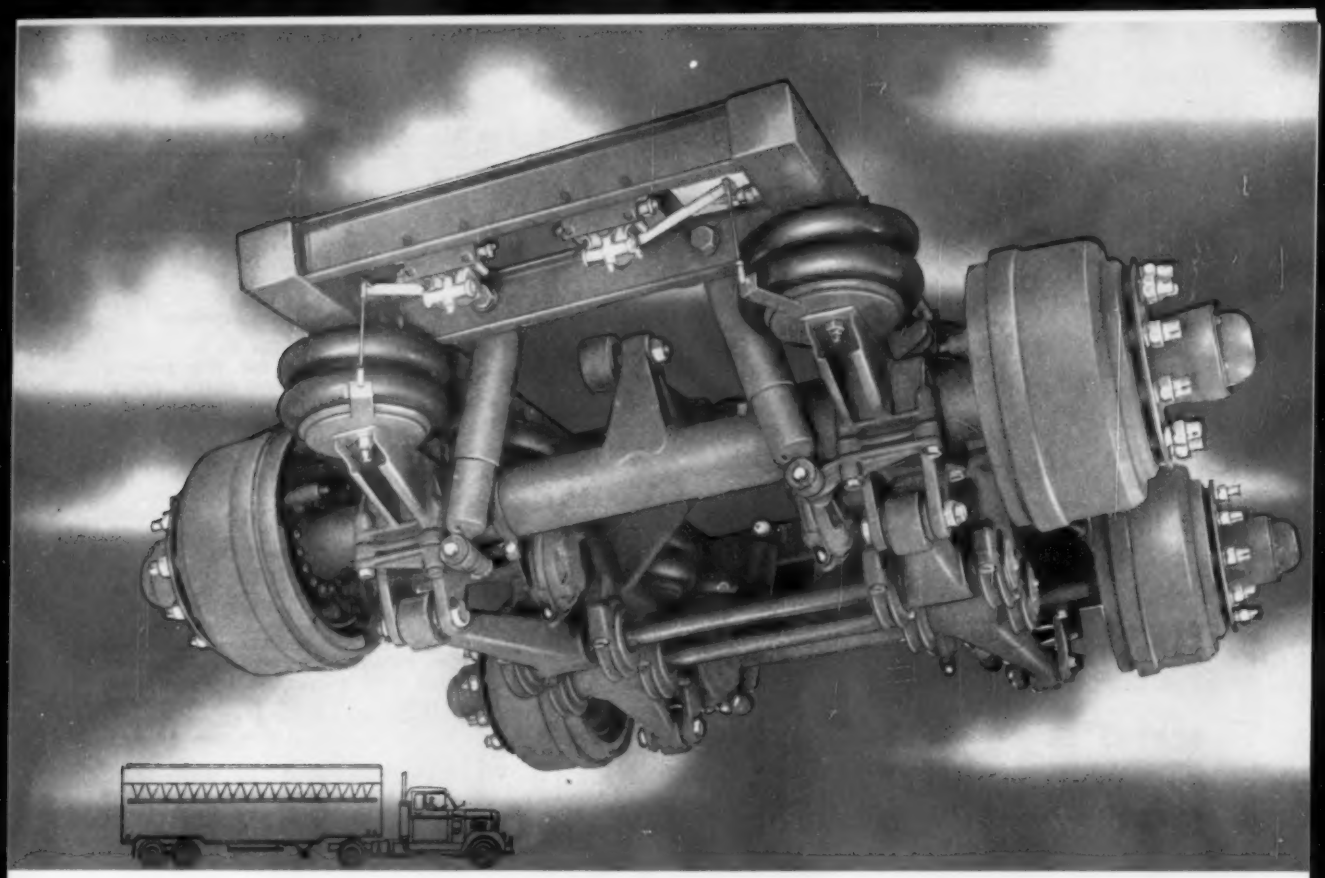

TONS OF HIGHWAY CARGO
FLOAT ON AIR
with the new Clark Air Suspension System for semi-trailers

Damage to fragile goods—to perishable cargo—to empty running vehicles can be *minimized* by the new Clark Air Suspension unit.

This unique undercarriage, suitable for installation on new or in-use semis, allows both trailers and cargo literally to "float on air"!

Smooth, soft ride . . .

Doughnut-shaped "air-springs" carry full weight of trailer and cargo, absorb road shock, "flatten" even *rough* highways to a surprising degree. Ride actually approaches passenger-car softness!

High stability . . .

Lateral roll and sway are minimized by ingenious system of pivoted torque arms and torsion bars which take full force of side loads and absorb torsion resulting from brake torque.

Automatic load leveling . . .

When loading or unloading trailer, air reservoirs automatically adjust to support trailer bed at normal running height.

Versatile package unit . . .

All Clark Air Suspension assemblies come as complete packages, ready for installation. Parts are interchangeable between single and tandem units. Either suspension assembly can be used on new trailers or those already in operation.

Lower maintenance costs . . .

Because compressed air does the flexing and rubber mountings are employed, no lubrication is needed. Tanker operators will find that tank splitting and cracking of returning "empties" is minimized. Operators of other types of trailers will also find their trailers lasting longer and requiring less maintenance.

Weight advantages . . .

Trailer manufacturers using the Clark Air Suspension System can lighten frame and body construction, increase longevity —without sacrificing load-carrying ability.

Why not investigate . . .

Whether you manufacture highway semi-trailers or operate them . . . whether you haul eggs or engines . . . whether one trailer or a hundred are involved . . . it will pay you to get the facts on Clark's new Air Suspended Trailer Axles. Ask us for detailed, illustrated Brochure No. AS-500

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PI-2

Pipeline Patrol

Status: Proposed.

• **Union Oil Co. of California**

Project: 815-mile line from Rifle, Colo., to Los Angeles refining area, to carry products from its Rifle shale-oil plant.

Status: Proposed.

U.S. Natural-Gas Pipelines

• **Arkansas Louisiana Gas Co.**

Project: A 300-mile line, plus gathering lines, from Tex.-La. coastal area to northern La., to connect with present system.

Status: Long-range plans.

• **Atlantic Seaboard Corp.**

Project: 6 miles of 26-in. from Petersburg to Moorefield, W. Va.

Status: Has temporary FPC approval.

Contractor: **Williams-Austin Construction Co.**

Completion: November 1957.

• **Carolina Pipeline Co.**

Project: 177 miles of 2, 3, 4, 6, 8, and 0-in. between Blacksburg and Camden, S. C.

Status: Under way.

Contractor: **Panama-Williams Corp.** and **P. A. Buchanan** have construction contract. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.

• **Central Hudson Gas & Electric Corp.**

Project: 46 miles of 10-in. from Albany to Kingston, N. Y.

Status: Under way.

Contractor: **Williams-Austin Construction Corp.**, O. L. Martin and Ralph Gaddy, supts., office at Catskill, N. Y.

Completion: December 1, 1957.

• **Central Illinois Light Co.**

Project: 20 miles of 10-in. from Peoria to Roanoke, Ill.

Status: Under way.

Contractor: **Somerville-Illinois Co.**, Joe Boyd, supt., office at Peoria.

Completion: November 1, 1957.

• **Cities Service Gas Co.**

Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.

Status: Under way.

Contractor: **Vaughn & Taylor Construction Co.**

Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles of 4-in. field lines in Eureka Field, Okla.

Status: Under way.

Contractor: **Prairie Construction Co.**

Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kans., Cass County, Mo., and Oklahoma County, Okla.

Status: Planned.

Project: 75 miles of 30-in. from Independence to near Welda, Kan.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Completion: December 1957.

• **Coastal States Gas Producing Co.**

Project: A 20-mile gathering system from the Rock Island area of Colorado County, Tex., to the United Gas Corp. system.

• **Coastal States Gas Producing Co.** and **Southern Coast Corp.**

Project: 45 miles of 2 to 10-in. in Bee County, Tex. to connect presently shutin fields with Texas Eastern Transmission Corp.'s system.

Status: Planned.

• **Coastal Transmission Corp.**

Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.

Status: Under way.

Completion: January 1, 1958.

• **Colonial Natural Gas Corp.**

Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one

THE LIQUID THAT BOSSES THE JOB

Thanks to the wizardry of modern machine builders, many industrial machines operate themselves, perform a series of complicated operations with little or no human attention.

To help do this important job they call on oil – special hydraulic oils that flow through complex systems of tubes to actuate controls. These oils must meet rigid requirements.

Texaco research has pioneered in developing this "life blood" of automation, one of the many ways it cooperates in furthering industrial progress.

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CATERPILLAR

PIPELINER WINS THE BATTLE OF THE MOJAVE DESERT

Unexpected rock. High winds. Rivers. Mountains. Sand. R. H. Fulton overcame them all with the help of its Caterpillar spread.

NEW CATERPILLAR NO. 572 PIPELAYER, left, teams up with No. 583 and the MDW8, lowering in on the Mojave Desert. The new No. 572 has a capacity of 86,000 pounds with a 19-inch ground clearance and 86-inch track gauge to give stability.

D9 WITH KELLY RIPPER (left) prerips unexpected rocky soil for ditcher. The Cleveland Ditcher (right) which follows is powered by a dependable Cat D339 Engine. The ditcher is cutting a depth of 65 inches at about 28 feet per minute.

NATURE put R. H. Fulton & Co. to the test during a 241-mile natural gas pipeline job across the Mojave Desert from Needles to Newhall, Calif.

Rock cropped up unexpectedly. Unseasonable high winds held up welding and painting, at times backfilled the ditch. Sand made maintenance of a firm ditch difficult. There were three river crossings and rugged mountainous terrain. But Fulton, with the help of its big Caterpillar spreads, overcame each obstacle, lowering in an average of 5,000 to 6,000 feet a day with a one-day high of 16,000 feet.

The 30-inch line is part of a $33.5 million joint expansion program of Southern California and Southern Counties Gas Companies. It will provide an additional 227.6 million cubic feet of gas per day.

Here are some of the problems Fulton encountered and how they were overcome:

ROCK—This occurred in stretches of presumably sandy material from 9 to 24 inches below the surface. By using huge Kelly Rippers mounted on the giants of the spread—CAT* D9 Tractors—a great deal of shooting was eliminated. The D9-Kelly Ripper combination preripped the rocky soil for the ditcher.

Because of danger of rock damage to pipe in backfilling, the entire length is padded on the bottom of the ditch and top of the pipe. Two Cat No. 977 Traxcavators* and a Crosse Ditch Padder side-mounted on a D8 were used for the padding operation. A D7, working with a No. 12 Motor Grader, backfilled.

WIND—Unseasonable high winds backfilled the ditch and periodically stopped welding and painting operation. But welding crews set a brisk pace in spite of the winds. Using Caterpillar* Twin Arc-Welders on Athey track wagons pulled by a D7, their best day was 16,200 feet.

MOUNTAINOUS TERRAIN—Rugged Kane Springs Canyon and the Ord Mountains had to be crossed. A D8 and D9 were used to winch a Northwest Backhoe over the steep canyon grade. Later, D9s towed stringing trucks in and out of the mountainous area.

Altogether, Fulton had almost 70 Caterpillar track-type Tractors and Pipelayers at work. In addition there were five Twin Arc-Welders, and dependable Caterpillar Diesel Engines powered cranes, backhoes and ditchers.

When it comes to the tough jobs, pipeliners know there is only one make of equipment designed to produce wherever the pipe takes them. That's why the standard color in fast-moving spreads throughout the world is Caterpillar yellow.

CAT TWIN ARC-WELDERS, mounted on Athey track wagons and pulled by a D7, helped make up for time lost due to high winds in the desert. Best day: 16,200 feet.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS, U. S. A.

*Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

Pipeline Patrol

in the Carolinas and Georgia.
Status: Proposed.

• **Colorado Interstate Gas Co.**
Project: 1957 program . . . 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
Status: Pending FPC approval. Has temporary approval for the 50 miles in Okla.

• **Eastern Shore Natural Gas Co.**
Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp. in Maryland, across entire length of Delaware to Salisbury.
Status: Pending FPC approval.

• **East Ohio Gas Co.**
Project: 90 miles of 24-in., and 23 miles of 30-in. from Richfield to Summerfield, Ohio.
Contractor: **Sharman, Allen, Gay & Taylor, Inc.,** James Adams, spread superintendent, office at Wadsworth, Ohio. **Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: November 1957.

• **Edison Securities Co.**
Project: 130 miles of 30-in. from San Joaquin Valley fields to Wilmington, Calif.
Status: Being contested by Southern California Gas Co., Southern Counties Gas Co., and Pacific Lighting Gas Supply Co.
Contractor: **Bechtel Corp.**

• **El Paso Natural Gas Co.**
Project: 81 miles of 18-in. and 13 miles of 20-in. from Panoma Plant, Gray County, to Dumas Plant, Moore County, Texas.
Status: Under way.
Contractor: **R. H. Fulton & Co. Coates Field Service, Inc.** has right-of-way acquisition and claims settlement contract.
Completion: November 1, 1957.
Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 74 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: January 1958.
Project: 216 miles of 6 to 34-in. and 533 miles of various size in Ariz., Tex., N. M.
Status: Filed for FPC permit.
Project: 47 miles of 30-in. from proposed Lindrith, N. M., plant to proposed Chaco, N. M., plant.
Status: Under way.
Contractor: **Foutz & Bursum Construction Co.**
Completion: 1957.
Project: 38 miles of various size line to make additional gas available at the McElroy-Wilshire plant near Crane, Tex.
Project: 500 miles of 34-in. from Twin Falls, Idaho to California border near Las Vegas, Nev.
Status: Planned.
Completion: September 1959.
Project: 131 miles of 4, 6, 8, 10, 12, 16, 18 and 20-in. gathering lines in Gray, Wheeler, and Collingsworth counties, Texas Panhandle.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: 1957.

• **Houston Texas Gas & Oil Corp.**
Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 139 miles of 18-in. and 101 miles of 20-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.
Status: To start November 1.
Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.
Completion: June 1958.

• **Iron Ranges Natural Gas Co., St. Paul.**
Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.
Status: Application pending with FPC.

• **Kansas-Nebraska Natural Gas Co.**
Project: 61 miles of various size gathering line in Camerick field, Texas County, Okla.
Status: Approved.

• **Manufacturer Light & Heat Co.**
Project: 3 miles of 12-in. from Wellsville to a point in Saline Township, Ohio; 8 miles of 12-in. in Brook County, W. Va.; 4 miles of 10-in. in Ohio County, W. Va.
Status: Has temporary FPC authority.

• **Michigan Consolidated Gas Co.**
Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.;** Floyd Huduall, supt., office at Cadillac.
Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.** jointly with **H. L. Gentry Construction,** Frank Morris, superintendent, office at Hart, Mich.

• **Midwestern Gas Transmission Co.**
Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., plus 648 miles of 3 to 18-in. extensions in Minn. and Wis.
Status: Application pending with FPC.

• **Mississippi River Fuel Corp.**
Project: 54 miles of 26-in. loops between Perryville, La., and Columbia, Ill.
Status: Under way.
Contractor: **Cape Construction Co., Inc.**
Completion: November 15, 1957.

• **Montana-Dakota Utilities Co.**
Project: 28 miles of 12-in. from Fallon County to Dawson County, Montana.
Status: Approved.
Project: 6 miles of 12-in. between Mandan and Bismarck, N. D.
Status: Has temporary approval.

• **Mountain Fuel Supply Co.**
Project: Extension of 12-in. line from Ogden to Logan and Brigham City, Utah.
Status: Has applied to Utah Public Service Commission.
Completion: Late 1957.

• **Natural Gas Pipeline Co. of America**
Project: 350 miles of 20 and 26-in. from

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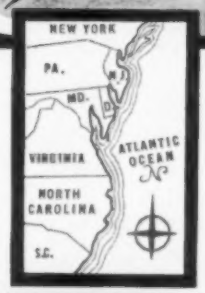

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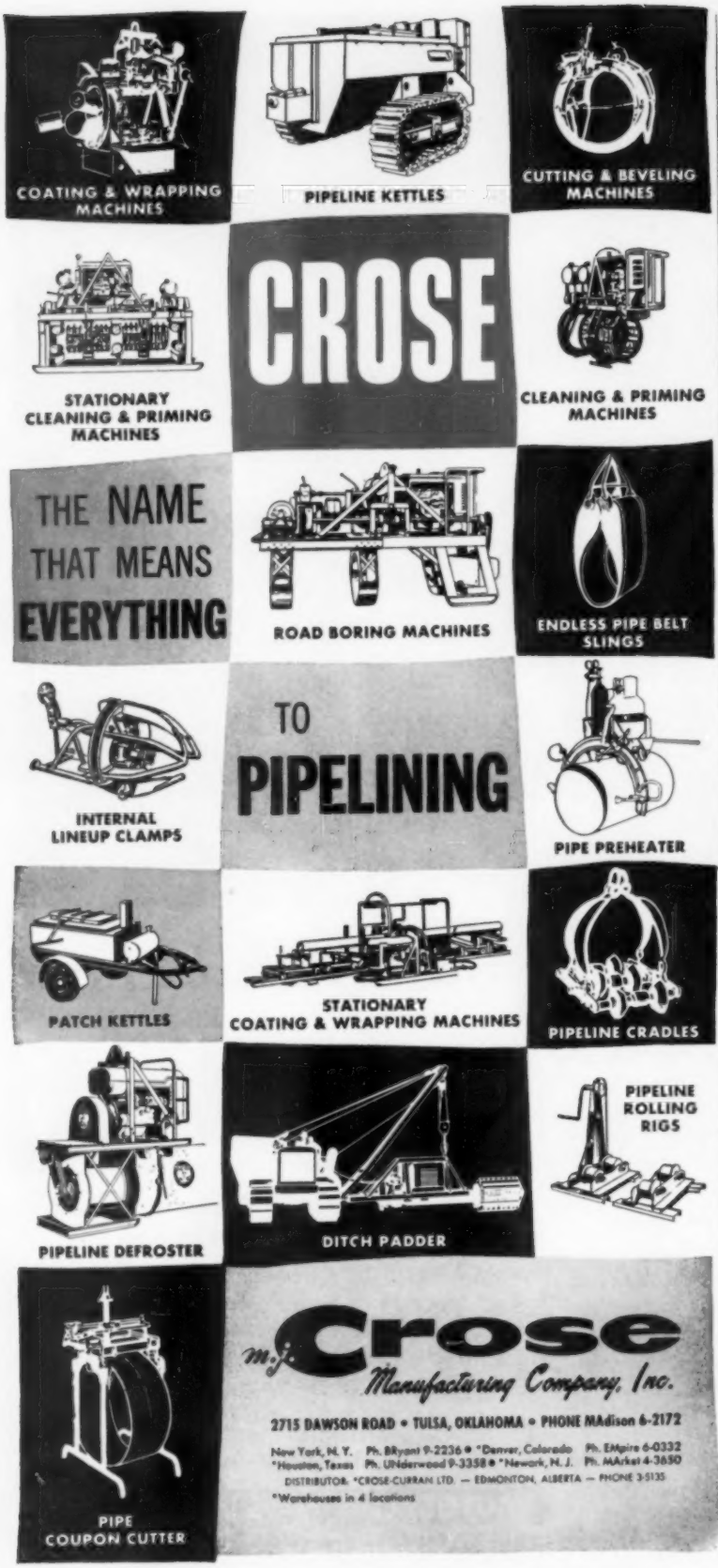
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Pipeline Patrol

Jack and Wise counties, Texas, to Fritch Tex., plus a gathering system.

Status: Under way.

Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County. **Fulton & Brodie, Inc.,** has gathering system. **Eastern Pipeline Contractors** has completed 86 miles of 20-in. from Bridgeport, Tex., to Healdton, Okla. **River Construction Corp.** has 86 miles of 26-in. from Mountain View, Okla., to Wheeler, Tex., Henry Arthur, spread supt., office at Hobart, Tex., and 87 miles of 26-in. from Wheeler to Fritch, Tex., D. C. White, supt., office at Pampa, both to be completed December 1, 1957. **H. B. Zachry Co.** has 88 miles of 26-in. between Ringling and Mountain View, Okla., Aldress Kilgore, supt., office at Duncan, to complete November 15, 1957.

Completion: January 1, 1958.

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and 91 miles of 30-in. loops along parts of its main line.

Status: Application pending with FPC.

Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of 36-in. between Beatrice and Joliet, Ill., along existing system.

Status: Pending FPC approval.

Completion: 1959.

• **Niagara Mohawk Power Corp.**

Project: 196 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York.

Status: Planned.

Contractor: Various.

Completion: December 31, 1957.

• **North Carolina Natural Gas Corp.**

Project: 630 miles of 2 to 16-in. from near Mooresville, eastwardly across N. C.

Status: To start fall 1957.

Completion: Spring 1958.

• **Northern Natural Gas Co.**

Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberdeen, S. D., line.

Status: Under way.

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savanna Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Proposed.

Project: 365 miles of main line and 1,090 miles of branch lines to serve communities in Minn., Iowa, S. D., Nebr., Wis.

Status: Filed with FPC March 18, 1957.

Project: 85 miles of 24 and 30-in. loops between Sunray, Tex., and Sioux City, Iowa.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Completion: December 1957.

Project: 13 miles of 16-in. to replace existing 10-in. line in Hansford County, Texas.

Status: Has temporary FPC authority.

• **Northern Utilities Co.**

Project: 35 miles of 16-in. in Fremont-Natrona County, Wyo., area; 8 miles of 12-in. around Casper; 6 miles of 8-in. from Sand Draw gas field to Beaver Creek field; 12 miles of 6-in. from Beaver Creek field to the system servicing the Riverton-Lander area.

Status: Planned.

• **Offshore Gathering Corp.,** Houston.

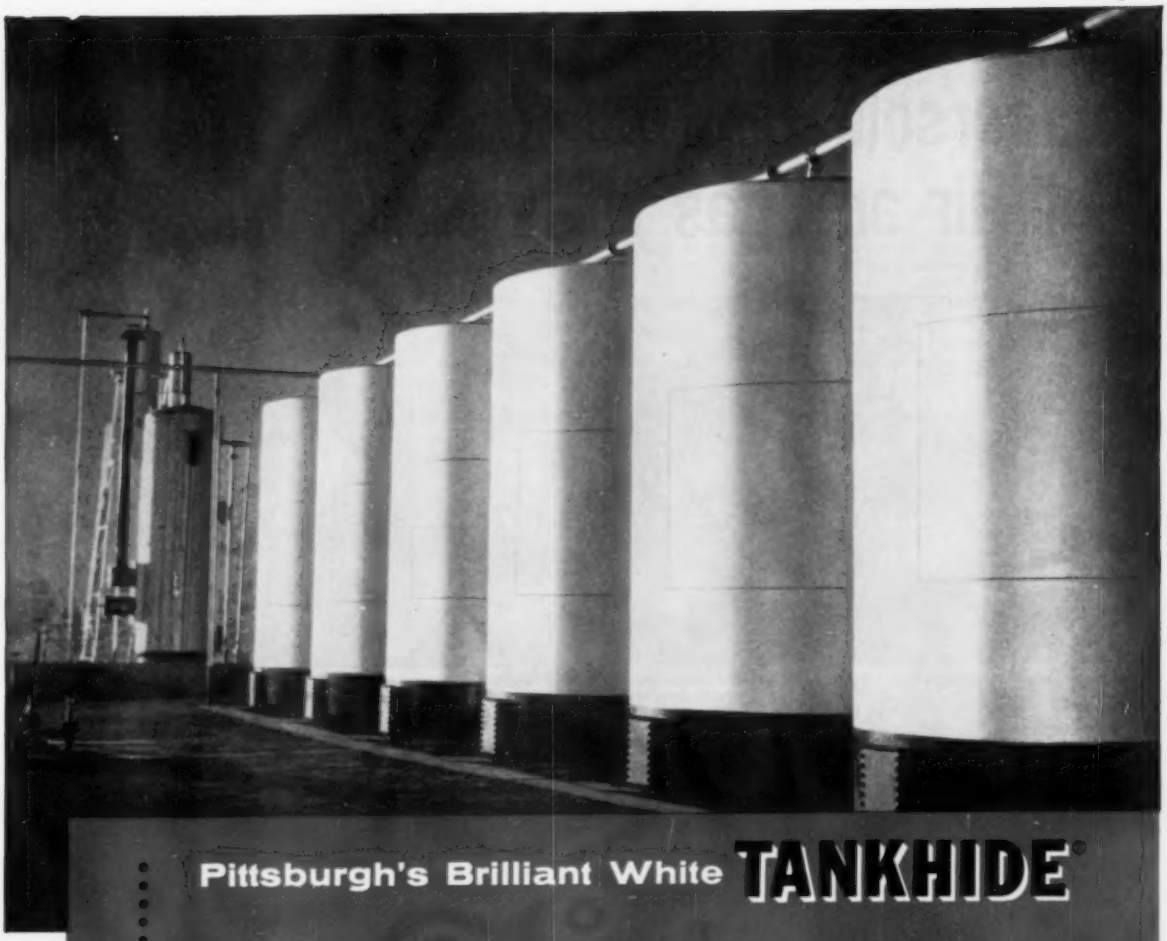
Project: 364 miles in Gulf of Mexico off Louisiana: 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Ohio Fuel Gas Co.**

Project: 30 miles of 24-in. looping from Pavonia to Attica, Ohio.

Status: Under way.



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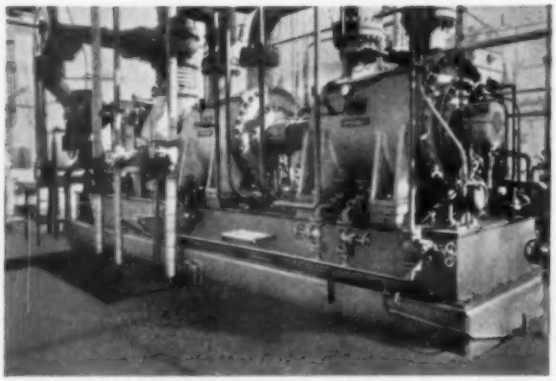
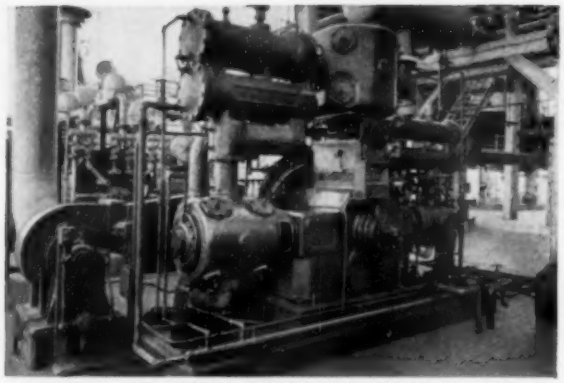
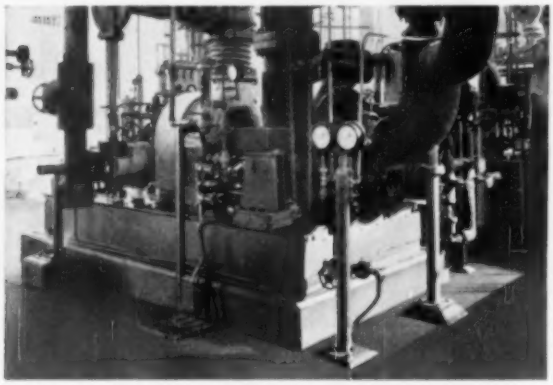


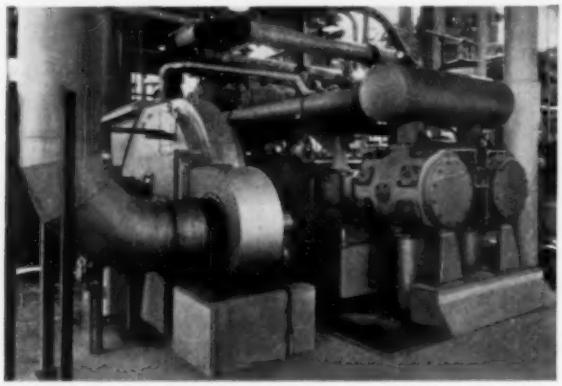
Hydrogen Gas is recycled by these two steam-turbine-driven Ingersoll-Rand vertically split centrifugal compressors arranged in series tandem. Final discharge pressure is 470 psi.



Inert Gas is handled by this TVH electric-motor-driven three-stage reciprocating compressor. Unit is rated at 500 psi.



Hot Gas at 680°F is circulated by this single-stage Ingersoll-Rand centrifugal that handles 3620 cubic feet per minute.



Compressed Air at 275 psi is furnished by this 700-hp Ingersoll-Rand HHE reciprocating compressor.

I-R centrifugal and reciprocating compressors also selected for No. 2 Ultraformer.

WHEN Amoco's No. 1 Texas City Ultraformer went on the line in February 1955, it was served by the Ingersoll-Rand centrifugal and reciprocating compressors shown above. For the No. 2 Ultraformer, scheduled to go into operation later this year, I-R centrifugal and reciprocating compressors were again specified to handle all air and gas requirements.

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Pipeline Patrol

Completion: November 25, 1957.

Project: 152 miles of line in Ohio: 43 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. near Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.

Status: Under way.

Contractor: **O. R. Burden Construction Corp.** has completed 43 miles of 24-in. from Sugar Grove near Crawford station, to Utica, Ohio, and 27 miles of 20-in. south from Wellston.

- **Pacific Gas & Electric Co.**

Project: 138 miles of 34-in. looping of the Topock-Milpitas line.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.**

Completion: December 1, 1957.

Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif.

Status: Planned.

Contractor: **Engineers Limited Pipeline Co.** and **Alex Robertson Co.**

Completion: January 1, 1958.

Project: 13 miles of 12-in., 2 miles of 10-in from Santa Cruz to Davenport, Calif.

Status: Planned.

Completion: October 1957.

Project: 1,300 miles of 36-in. from Alberta to San Francisco.

Status: Proposed.

Completion: 1960.

- **Pennsylvania Gas Co.**

Project: 23 miles of 10-in. in Erie County Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pa., 30 miles of branch lines, several small distribution lines.

Status: Has FPC permit.

- **Permian Basin Pipeline Co.**

Project: 83 miles of 16-in. from its Spraberry station in Midland County, Tex., to tie in with Pioneer Gathering System, Inc. in northwestern Schleicher County, Tex.

Status: Under way.

Contractor: **Lone Star Constructors**, H. A. (Red) Wylie, supt.

Completion: November 1957.

- **Phillips Petroleum Co.**

Project: 30 miles of 3 to 8-in. in Moore Hutchinson, Sherman, Hansford, and Gray counties, Tex., and in Texas County, Okla.

Status: Planned.

Contractor: Various.

Completion: January 1, 1958.

- **Piedmont Gas Co.**

Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell and Burke counties.

Status: Has FPC approval.

- **Pioneer Gathering System, Inc.**

Project: 70 miles of mostly 16, 12-in. in Val Verde, Schleicher, Sutton counties, Tex.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Competion: Early fall 1957.

- **Southern Natural Gas Co.**

Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.

Status: Has FPC approval.

Completion: December 1, 1957.

Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field 7 miles of 8-in. laterals in Manila Village Field.

Status: Has FPC approval.

Completion: December 1, 1957.

Project: 14 miles of 24 and 26-in., 62 miles of 20-in., 48 miles of 16-in., 21 miles of 12-in., 14 miles of 10-in., and 51 miles of smaller lines in La.

Status: Pending FPC approval.

- **Spokane Natural Gas Co.**

Project: 400 miles of 1 through 24-in. distribution system at Spokane.

Status: Under way.

Contractor: **Hallmac Construction Co.**; V. L. Williams, supt., office at Spokane.

Completion: 1957.

- **Tennessee Gas Transmission Co.**

Project: 10 miles of 24-in. loop near New Castle, Pa.

Status: Under way.

Contractor: **Harford Brothers Pipeline Contractors.**

Project: Triple 24-in. underwater crossing of Mississippi River near Greenville, Miss.

Status: Under way.

Contractor: **Pentzien, Inc.**, and **Collins Construction Co.**

Project: 71 miles of 26-in., 10 miles of 20-in., 16 miles of 16-in., and 10 miles of 12-in. gathering lines from near Kinder, La., southward to offshore fields in Gulf of Mexico.

Status: Under way.

Contractor: **Brown & Root, Inc.** has all except for 50 miles of 26-in., C. M. Spears, supt., office at Lake Charles.

Completion: December 1, 1957.

Project: 556 miles of 30-in. from Mississippi Delta area south of New Orleans to Porland, Tenn.

Status: Pending FPC approval.

Project: 76 miles of 24-in. from Couders-

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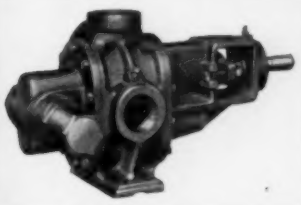

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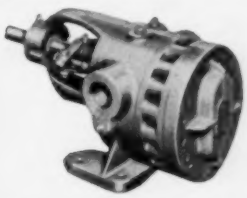

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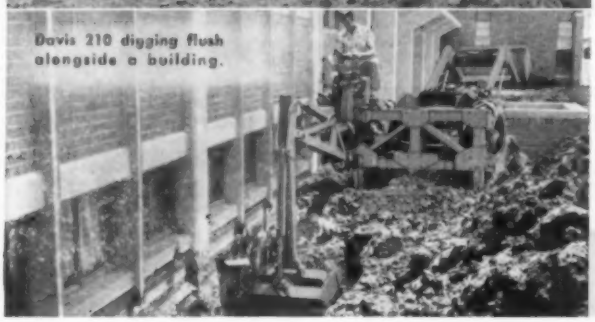

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port, Pa., to Hamburg, N. Y.
Status: Pending FPC approval.
Project: 163 miles of 30-in. and 101 miles of 26-in. from Portland, Tenn., to near Lancaster, Ky.; from Winchester, Ky., to Morehead, Ky.; from Catlettsburg, Ky., toward Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from Morehead, Ky., to Catlettsburg, Ky.
Status: Pending FPC approval.

- **Texas Gas Transmission Corp.**
Project: 20 miles of 18-in. near Bastrop, La.
Status: Under way.
Contractor: **Houston Contracting Co.**, W. H. Hayes, supt., office at Bastrop.
Completion: Fall 1957.

- **Texas Eastern Transmission Corp.**
Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.
Status: Has FPC approval.
Project: 140 miles of 30-in. between Kosciusko, Miss., and Uniontown, Pa., 105 miles of 30-in. between Opelousas, La., and Kosciusko, 22 miles of 14-in. supply line in La.
Status: Pending FPC approval.
Project: 667 miles of 30-in. from Kosciusko, Miss., to Uniontown, Pa.
Status: Under way.
Contractor: **H. C. Price Co.** (64 miles from Barton, Ala., to Mount Pleasant, Tenn.; 51 miles from Mount Pleasant to Gladeville Tenn.; 52 miles from Gladeville to Tompkinsville, Ky.; 68 miles from Tompkinsville to Danville, Ky.; 63 miles from Danville to Owingsville; 46 miles from Owingsville to Wheelersburg, Ohio. Will use four spreads). **Williams Brothers Co.** (63 miles from Egypt, Miss., to Barton, Ala.; 64 miles from Berne, Ohio, to Uniontown, Pa.); **Houston Contracting Co.** (80 miles from Kosciusko to Egypt, Miss., M. L. Thompson, supt., office at Ackerman; 57 miles from Wheelersburg to Athens, Ohio, W. H. Hayes, supt., office at Oak Hill; 61 miles from Athens to Berne, Ohio, R. E. Thornton, supt., office at Chauncey).
Completion: Fall 1957.

- **Texas Illinois Natural Gas Pipeline Co.**
Project: 44 miles of 36-in. and 4 miles of 34-in. from south of Joliet, Ill., to Howard Street, west of Chicago.
Status: Under way.
Contractor: **Midwestern Constructors, Inc.**, John Work, supt., office at Aurora.

- **Transcontinental Gas Pipe Line Corp.**
Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller size loops from Tex. to N. J.
Status: Work in North Carolina under way.
Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along system in S. C., N. C., Pa., and Va. Work will start in N. C., office at Winston-Salem.
Completion: December 1957.
Project: 110 miles of 36-in., 16 miles of 30-in., and 13 miles of 24-in. looping in S. Car., Ga., Ala., Miss., and La.
Status: Under way.
Contractor: **Sharman, Allen, Gay & Taylor Inc.**, E. D. Singleton, superintendent.
Completion: November 1957.
Project: 57 miles of 30, 36-in. loops in La., Miss., Ala., Ga., S. C., and 247 miles of mostly 24 and 16-in. laterals in Tex. and La.
Status: Under way.
Completion: December 1957.
Project: 87 miles of 24-in. laterals, plus small gathering lines connecting seven Louisiana fields with the New Orleans area.
Status: Pending FPC approval.

- **Trans-Western Pipe Line Co.** (Warren Petroleum, Monterey Oil Co., J. B. Butler.)
Project: A line from Four Corners area to Calif. border.
Status: Proposed.

- **United Gas Pipe Line Co.**
Project: 18 miles of 12-in. from Lirette-Mobile line in Jackson County, south to Bayou Casottee industrial area east of Pascagoula, Miss.
Status: Filed for FPC permit.

- **Western Slope Gas Co.**
Project: 36 miles of 4-in. from Piceance Creek field in northwestern Colo., to Rifle Colo.
Status: Under way.
Completion: October 1957.

Canadian Crude-Oil Pipelines

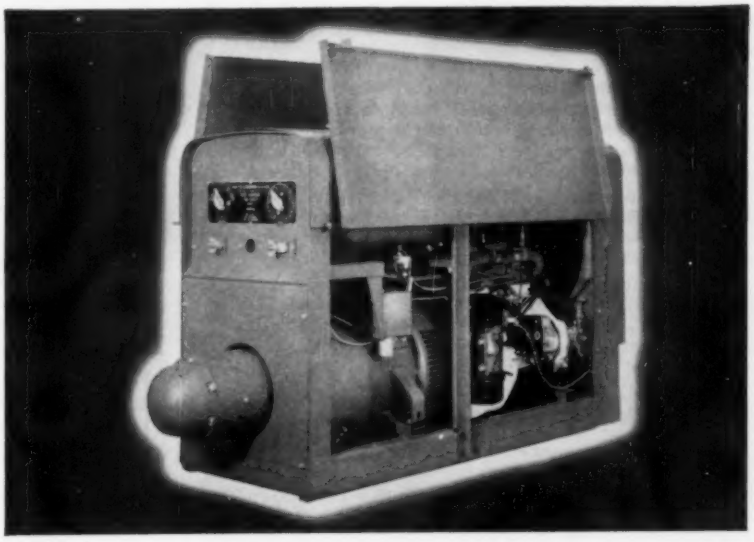
- **Act Oils, Ltd.**
Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.
Status: Request has been made for permit from the B. C. government.

- **B-A Alberta Pipe Line, Ltd.**
Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.
Status: Pending approval.

- **Gibson Petroleum Co., Ltd.**
Project: 25 miles of line from Willesden Green field to near Rimbey, Alta.
Status: Has Alberta Government approval.

- **Pembina Pipe Line, Ltd.**
Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field, Alta.
Contractor: **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., has 65 miles of 3 to 6-in., Odis Hare, supt., office at Drayton Valley, Alta.
Completion: November 15, 1957.

- **Royalite Oil Co., Ltd.**
Project: 250-mile line from Athabasca oil



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Kaiser Aluminum sheet for jacketing offers new economies through improved application methods

Recent developments make possible new low costs for the power, refinery and chemical industries

As you can see in the relative cost charts at the right, aluminum sheet jacketing now offers the *lowest first cost* of four well-known finishing methods for pipe insulation . . . and it offers *lower first cost* than wet-construction finishing methods for vessel insulation.

Another important fact, not revealed in the charts, is that aluminum's first cost is becoming *increasingly* competitive, thanks to newly-developed methods that speed application and reduce labor costs!

And if maintenance costs were added to the comparisons, aluminum would present an *even better value*—because only aluminum eliminates maintenance.* Its remarkable resistance to corrosion eliminates the need for painting . . . even when exposed to weather and mechanical abuse.

New Dry Wall Construction for Vessels

A number of improvements in application technique—developed by Kaiser Aluminum engineers in cooperation with specialists from various industries—adapt dry-wall type construction to the finishing of large cylindrical and flat insulated surfaces. These techniques virtually eliminate the need for costly application methods used to apply wet materials such as insulating cements, emulsions, mastics, adhesives, glue sizing and paint. Where corrugated aluminum sheets are used, positioning and fastening are simplified and speeded by familiar techniques employed for block insulations.

New "Snap-Back" Aluminum Jacketing Speeds Installation on Piping

Aluminum's unique advantages in light weight and superior workability have made possible greatly simplified preformed "snap" jackets for quick, easy application on piping.

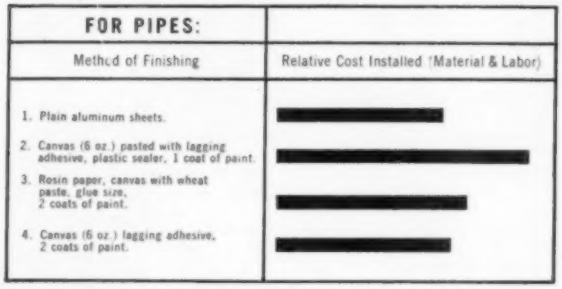
Jacketing, preformed into undersize tubes from stiff sheets of aluminum, will snap back to a tight fit when placed over pipe insulation, freeing both hands for fastening. This tight fit requires less fasteners per running foot.

The following is an outline discussion of important factors in aluminum jacketing materials and alloys, with suggested application methods best suited to various insulated surfaces, including pipes, vessels, vessel heads and others.

The Jacketing Alloys

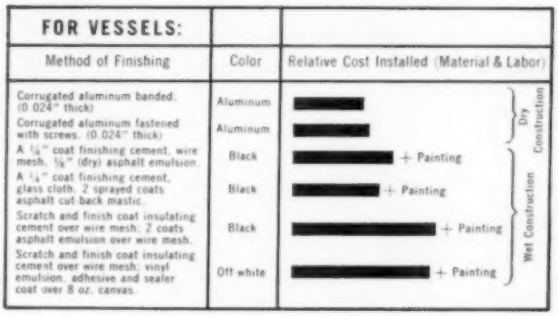
The following aluminum alloys, supplied in flat or coiled sheets, are successfully used for insulation jacketing: 1100, 3003, 3004, 5005, 5050, 5052, Kaiser Aluminum industrial roofing and siding alloy, and Kaiser Aluminum standard roofing alloy.

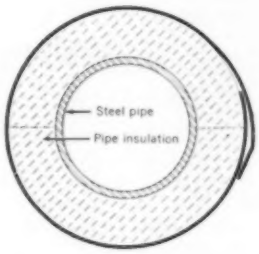
*Roofing felt has a lower initial cost than aluminum, but painting and maintenance offset this initial cost advantage.


FOR PIPES:
Method of Finishing
Relative Cost Installed (Material & Labor)
1. Plain aluminum sheets.
2. Canvas (6 oz.) pasted with lagging adhesive, plastic sealer, 1 coat of paint.
3. Rosin paper, canvas with wheat paste, glue size, 2 coats of paint.
4. Canvas (6 oz.) lagging adhesive, 2 coats of paint.

Results of first cost analyses of various insulation finishes

NOTE: Charts show first costs only. To arrive at total costs, maintenance costs must be added. Whereas other finishing methods require frequent and costly maintenance, aluminum jacketing is virtually maintenance-free.


FOR VESSELS:
Method of Finishing
Color
Relative Cost Installed (Material & Labor)
Corrugated aluminum banded. (0.024" thick)
Aluminum
Corrugated aluminum fastened with screws. (0.024" thick)
Aluminum
Dry Construction
A ¼" coat finishing cement, wire mesh, ⅛" (dry) asphalt emulsion.
Black
+ Painting
A ¼" coat finishing cement, glass cloth, 2 sprayed coats asphalt cut back mastic.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; 2 coats asphalt emulsion over wire mesh.
Black
+ Painting
Scratch and finish coat insulating cement over wire mesh; vinyl emulsion, adhesive and sealer coat over 8 oz. canvas.
Off white
+ Painting
Wet Construction



Sketch shows how preformed jacketing snaps back over piping, providing quick installation combined with tight fit. This is also demonstrated in photo titled "Teamwork."

Based on maximum economy and performance, the general recommendation is the use of Kaiser Aluminum alloy 5005 and Kaiser Aluminum industrial roofing and siding.

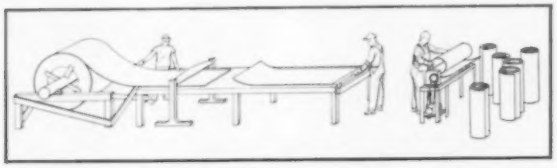
The reasons for this recommendation, and the exceptions to it, are as follows:

(a) Alloys in the 5000 series (which contain magnesium as the principal alloying element) and the clad alloys, such as AlClad 3004 (from which Kaiser Aluminum industrial roofing and siding sheet is made), offer superior corrosion resistance—especially in marine atmospheres.

(b) Alloy 5005 and the industrial roofing and siding alloy provide top performance at lowest cost for most jobs. Alloy 5050 shows an advantage from the standpoint of strength over 5005, and in many instances its slightly increased cost (a fraction of a cent per square foot) is warranted. Where exceptional strength is required, alloy 5052 should be used.

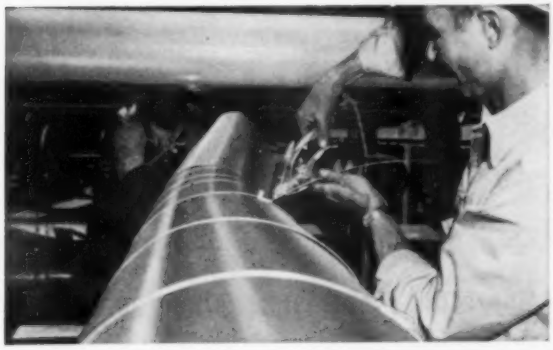
(c) Closely allied with alloy selection is a consideration of the section modulus of jacketing for large diameter vertical vessels. Kaiser Aluminum industrial roofing and siding sheet is superior in section modulus. On certain vertical vessels, usually those in the range of 3′ to 12′ in diameter, some designers prefer the close-up appearance of smaller corrugations. When this is preferred, most of the common alloys and the standard corrugated roofing alloy are satisfactory. Sheets should be 0.024″ thick, embossed, corrugated to 1¼″ x ¼″, and supplied in finished widths of 26″.

A metal thickness of 0.024″ is recommended in most cases. Corrugated aluminum 0.024″ thick can be banded at less material and labor cost than the thinner 0.019″ material fastened with screws. For insulated pipes with an O.D. of 12.75″ and less, 0.020″ thick aluminum sheet is recommended.



These illustrations show method used to fabricate snap jackets:

1. Using aluminum of proper alloy and temper . . .
2. Cutting it to proper dimensions for easy, economical installation . . .
3. Properly stiffening the overlapping edge by a simple angular crimp . . .
4. Forming it through a roller for proper circumference . . .
5. Snapping it around insulated pipe (below).



Teamwork—with one man to snap jackets in place and another to band them, two men can cover 700 feet of 10-inch diameter tubing in one day!

The best temper for pipe jacketing is ¾ hard, designed as H-16 or H-36. For fitting jackets requiring numerous lock seams, ½ hard temper, H-14 or H-34, is recommended.

Pipe Jackets

Snap jackets are a quick, easy and economical method of enclosing insulated pipe. The simple process shown above produces a most effective jacket for pipe insulation. (Kaiser Aluminum's booklet, *"Insulation Jacketing Materials and Methods,"* explains and describes the process in full detail.)

The alloy recommended is 5005-H16, in coiled sheet form with plain finish. Embossed finishes are also available. Other alloys may be used, but it is desirable to use one alloy throughout. Width of coiled sheet should be 36″. Recommended thicknesses of sheets are 0.020″ for insulation O.D. of 12.75″ and under, and 0.024″ for insulation O.D. of 14″ and larger.

Vessel Jackets

Insulated vessels 36″ O.D. and less—horizontal or vertical—should be jacketed with 0.024″ thick by 36″ wide 5005-H16 alloy sheet, plain finish preferred.

For insulated vessels larger than 36″ O.D., horizontal mounting, use the same coiled sheet as above; for vertical mounting, use Kaiser Aluminum industrial roofing and siding, 0.024″ thick, embossed finished, ⅞″ deep corrugations with 2.67″ pitch.

Jackets for Large, Flat Surfaces

For breechings and ducts, indoors and out, Kaiser Aluminum industrial roofing and siding, 0.024″ and 0.032″ thick and having ⅞″ deep by 2.67″ pitch corrugations are most economical. Flat sheet, fluted sheet, and flat sheets stiffened with roll-formed standing seams offer other possibilities.

For insulated boiler walls, jackets may be made of aluminum sheets of several types. Thickness, size and fastening method will vary with specific boiler designs.

Fasteners

For pipes and vessels with insulation O.D. 36″ or smaller, bands may be slit from the same aluminum sheet used for pipe jackets, or they may be purchased as standard stock items. For pipe insulation O.D. 12.75″ and smaller, bands should be ½″ wide by 0.020″ thick, equal to A. J. Gerrard #305-AL; seals should be equal to A. J. Gerrard #202-AL. For pipe or vessels with insulation O.D. 14″ to 36″, bands should be ¾″ wide by 0.020″ thick, equal to A. J. Gerrard #311-AL; seals should be equal to A. J. Gerrard #204-AL. For vessels with insulation O.D. 36″ and larger, ¾″ wide by 0.020″ thick #18-8 stainless steel expansion bands should be used. Banding should be equal to A. J. Gerrard Expand-R-Strap, #E311 ½ S-4; seals should be #18-8 stainless steel, equal to A. J. Gerrard #204-SS.

When required for pipe and fitting jackets, #7 by ½″ aluminum pan head self-tapping screws, Type A, are suggested. Side laps and flashing with corrugated vessel jackets should be fastened with #7 x ¾″ aluminum pan head screws, Type A. Aluminum screws should be made from either 6061-T6 alloy or anodized 2024. For fastening aluminum jackets to steel structural members, use #14 hex head screws, Type B, made from stainless steel #18-8 alloy; #410 is acceptable.

Composite studs made from #18-8 stainless steel and aluminum (equal to Nelson Rivweld Studs or to Nelson Set Lock Studs supplied with aluminum washers) may be used to fasten corrugated aluminum jackets to angles. On siding, fasten studs on low part of corrugation. On roofing, fasten studs on crown of corrugation.

Aluminum Jacketing Booklet Available

Kaiser Aluminum's new booklet, *"Insulation Jacketing Materials and Methods,"* gives you complete details on the subjects outlined above. It also presents illustrated step by step application methods plus material and accessories charts to help you take advantage of recent advances in aluminum sheet jacketing. Forty fully illustrated pages in all! To get your free copy, write to: *Kaiser Aluminum & Chemical Sales, Inc., Process Industries Department, 919 N. Michigan Ave., Chicago 11, Illinois.*

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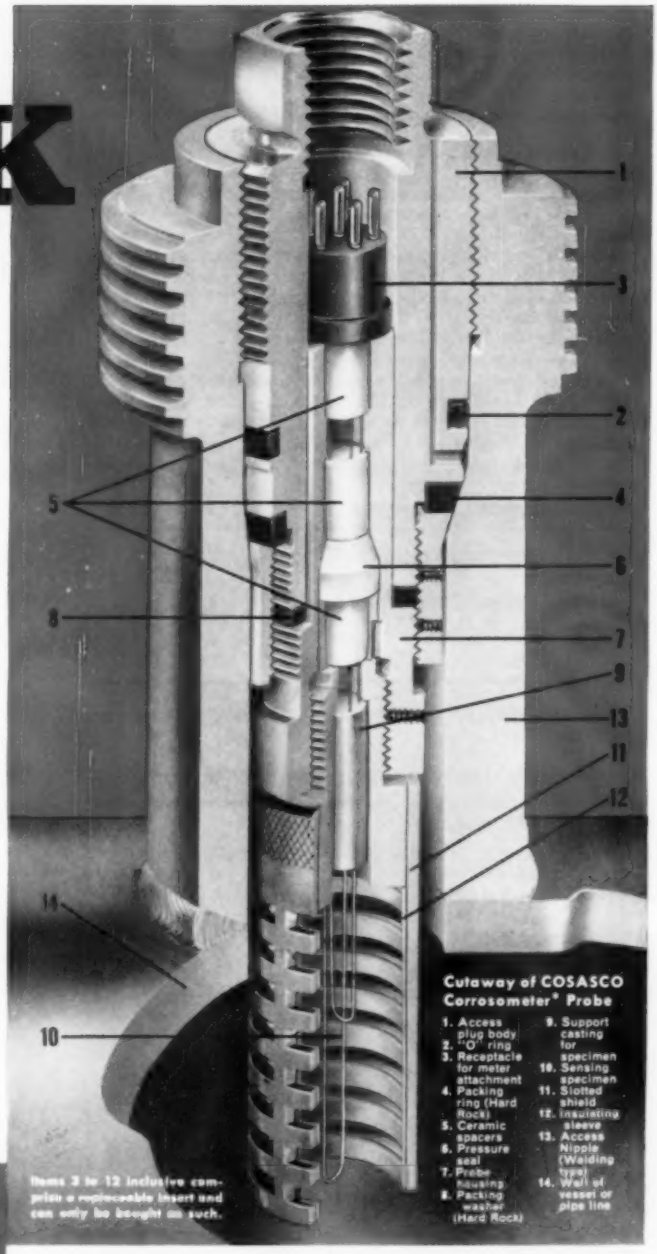

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Pipeline Patrol

sands, northeastern Alta., to Edmonton.
Status: Long range plans.
Completion: 1960.

• **Westspur Pipe Line Co.**
Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings, Florence, Carnduff, and Glen-Ewen fields; 34 miles of 4, 6, 8-in. gathering lines.
Status: Has requested permit from Board of Transport Commissioners.
Contractor: **Majestic Contractors, Ltd.** Jeff Minter, supt., office at Estevan, Sask.
Completion: No date set.

Canadian Products Pipelines

• **Hydrocarbons Pipeline Co.**
Project: 800 miles of 6 and 8-in. LPG line from near Edmonton, Alta., to Fort William, Ont.
Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start in 1957.
Construction consultants: **Dutton-Williams Brothers, Ltd.,** and **A. D. Little Co.**

Canadian Natural-Gas Pipelines

• **Alberta Gas Trunk Line Co., Ltd.**
Project: 637 miles of 34 to 16-in. gathering lines in Alberta.
Status: Under way.
Contractor: **Dutton-Williams Brothers, Ltd.** has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.** subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.,** has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.,** has completed 17 miles of 34-in. west from Burstall, Sask., to near Cavendish, Alta., and 100 miles of 18-in. north to Bindloss and Provost fields.

• **North Canadian Oils, Ltd.**
Project: 47-mile extension into Jasper, Alta. of its 10-in. line from Wabamun to Hinton west of Edmonton.

• **Northern Ontario Pipe Line Crown Corp.**
Project: 675 miles of 30-in. from the Ontario-Manitoba border to near Kapuskasing, Ont. (part of the 2,250-mile Trans-Canada line; will be leased to Trans-Canada Pipe Line Co. with option to buy.)
Status: Under way.
Contractor: **Dutton Williams Brothers has 58 miles from the Manitoba-Ontario border west of Kenora to a point east of the crossing of Ontario Highway 17. Morrison Shivers, Ltd. has 94 miles from the east crossing of Highway 17 to a line separating the townships of Hyndman and Hodgson. Majestic Contractors, Ltd.,** and **Nelen, Ltd.,** have 80 miles from the Morrison Shivers terminal to Stedman Township, W. B. Williams, supt., office at Ignace, to complete October 31. **Houston Contracting Co.** has 79 miles from Stedman to Forham Township, R. L. Sinar, supt., office at Raith, Ont. **River Construction Corp.,** has Winnipeg River crossing near Kenora, Ont., to complete November 15, 1957.
Completion: End 1957.

• **Quebec Natural Gas**
Project: 34 miles of 16 to 24-in. across center of Island of Montreal.
Status: Under way.
Completion: November 15, 1957.

• **Trans-Canada Pipe Lines, Ltd.**
Project: 310 miles of 20-in. from Toronto to Montreal, 33 miles of 24-in. from Toronto to Niagara, N. Y.
Status: Under way.
Contractor: **Oklahoma Pipe Line Constructors** (83 miles of 20, 24-in. from Toronto to Whitby, Ont., Lemon Crech, supt., office at Brampton, to complete November 1, 1957); **Grayco Constructors, Inc.** (120 miles of 20-in. between Toronto and Montreal). **Dutton Williams Bros.** (114 miles between Toronto and Montreal).
Completion: Late 1957.
Project: 30-in. Winnipeg River dual line at Kenora, Ont.
Status: Under way.
Contractor: **Canadian River Construction,** Vernon Gayhart, supt., office at Kenora, Ont.
Completion: November 15, 1957.

• **Union Gas Co. of Canada, Ltd.**
Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 5 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.
Status: Under way.
Contractor: **Canadian Bechtel, Ltd.** has the 26-in. line with 2 spreads working: J. L. Work, supt., office at Galt, H. F. Mogg, supt., office at Strathroy.
Completion: November 30, 1957.

• **Westcoast Transmission Co., Ltd.**
Project: 42 miles of 20-in. and 100 miles of 30 in. from Savanna Creek area, Alta., to Canadian-Idaho border.
Status: Planned.
Completion: November 1, 1958.
Project: 150 miles of 4 through 26-in. gathering lines at Fort St. John, B. C.
Status: Under way.
Contractor: **Canadian River Construction,** E. L. (Tex) Maggard, supt., office at Dawson Creek.
Completion: October 31, 1957.

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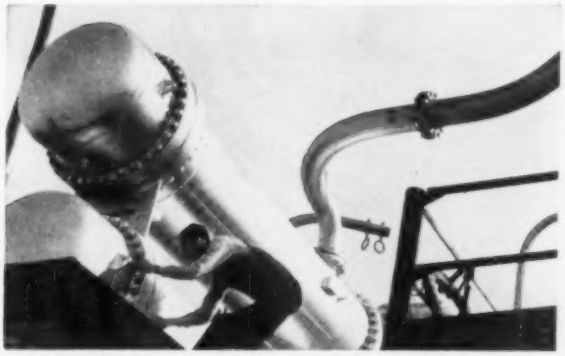

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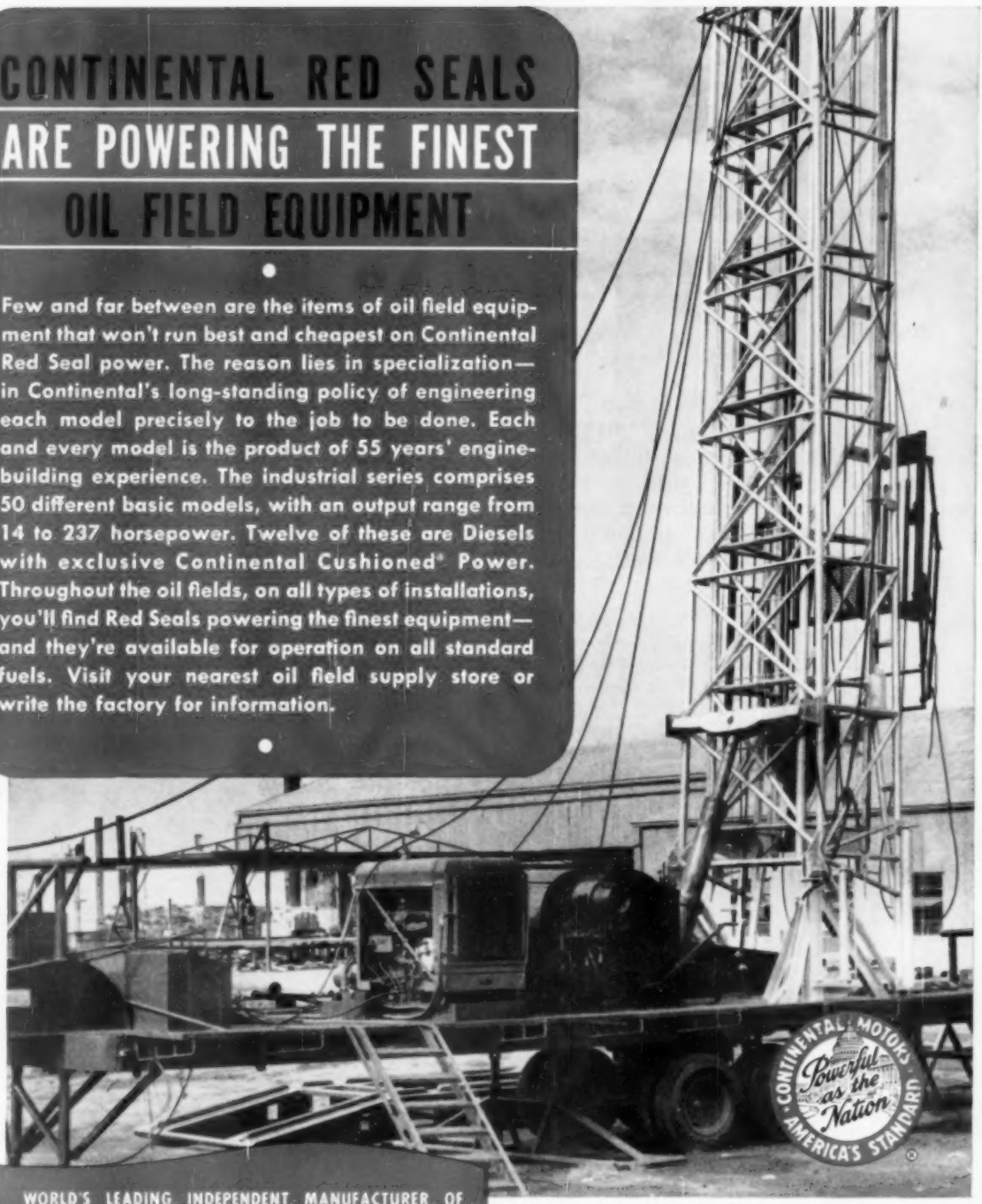

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Pipeline Patrol

Foreign Crude-Oil Pipelines

• **Bolivian Gulf Oil Corp.**
Project: 160 miles of 10-in. and 43 miles of 8-in. from Sicasica to Arica on the Chilean coast.
Status: To start late 1957.
Contractor: **Williams Brothers Co.**
Completion: 1958.

• **Bolivia-Paraguay**
Project: 500 miles of 6-in. from Southeast Bolivia to a proposed refinery on Paraguay River, and later to Asuncion.
Status: Planned.
Contractor: Five Lilles, a French Combine.

• **Burmah Oil Co., Ltd.**
Project: 850 miles of 20-in. from Nahorkatiya to Calcutta, India.
Status: Survey under way.
Contractor: **Collins Construction Co.** is surveying locations for some 40 river crossings.

• **Caltex**
Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles to Minas field later.
Status: Planned.
Completion: Duri-Dumai line to be finished in 1959; extension to Minas later.

• **Colombian Petroleum Co.**
Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.
Status: Under way.

• **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**
Project: Two 10-in. lines from Hassi Messaoud and Edjele, Algeria to the railhead at Touggourt.
Status: Planned.
Completion: 1958.
Project: 450 miles of 16-in. from Edjeli field in southeastern Algeria to a Mediterranean port on the Libyan coast.
Status: Pipe has been ordered.

• **Creole Petroleum Corp.**
Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.
Status: To start work early 1958.
Contractor: **Pipe Line Engineering Co.** and **Oklahoma Pipe Line Constructors.**
Completion: April 1958.
Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.
Status: Planned.
Completion: Late 1957.

• **Deutsche-Shell A.G.**
Project: 120 miles of 20, 24-in. from Marseilles, France, to Rotterdam, Germany, to tap the 700 mile trans-Europe line proposed by the Royal Dutch-Shell Group.
Status: Planned.
Completion: 1960.

• **Iraq Petroleum Co.**
Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq to Turkish port of Iskenderun on the Mediterranean.
Status: Proposed. Survey completed.

• **Mene Grande Oil Co.**
Project: 97 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.
Status: Under way.
Contractor: **Fulghum Contracting Corp.** has 22 miles between Oficina and Anaco.
Completion: First quarter 1958.
Project: 45 miles of 24-in. from Oficina to Melones, Venezuela.
Status: Planned.
Completion: First quarter 1958.

• **Middle East Pipeline**
Project: 1,500 miles of 38 and 40-in. line from Persian Gulf to Mediterranean at Iskenderun, Turkey.
Status: Proposed.

• **National Iranian Oil Co.**
Project: A 1,000-mile 38-in. line to move Qum crude to the Mediterranean.
Status: Transit agreement approved.

• **North-West Oil Pipeline Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)
Project: 230 miles of 28-in. from refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.
Status: Work to start early 1958.
Completion: November 1958.

• **Royal Dutch-Shell**
Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.
Status: Company is considering project together with several other companies.

• **Standard-Vacuum Petroleum Maatschappij**
Project: 94 miles of 8-in. from Lirik field, Central Sumatra, to deep-water terminal on Siak River, near Buatan. A 3-in. hot-water "defroster" line will be laid under the 8-in. to heat the heavy crude.
Status: Under way.
Completion: Late 1957.

• **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**
Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.
Status: Under study.

• **Union of Soviet Socialist Republic**
Project: 2,300-mile Trans-Siberian crude-products line from Ufa Tuimaza fields in Bashkiria to Irkutsk near Lake Baikal.

• **Yacimientos Petroliferos Fiscales** (Argentina)

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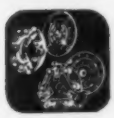
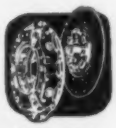
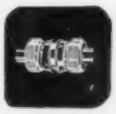

Small Spring Loaded


Heavy Duty Spring Loaded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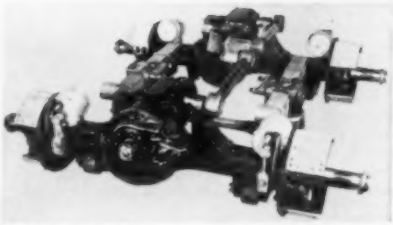

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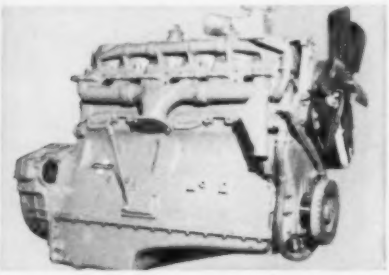

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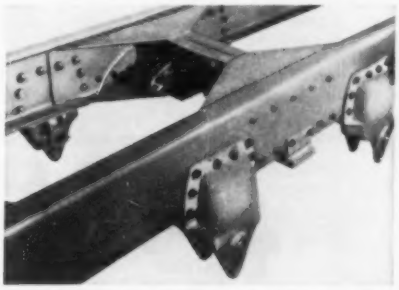

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Pipeline Patrol

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.
Status: Planned.
Contractor: **TIPSA** (Fish Engineering Corp., Fish Northwest Constructors, Inc., Clark Brothers, North American Utility, Construction International Co.).
Project: 625 miles of 12-in. from Mendoza to San Lorenzo.
Status: Planned.

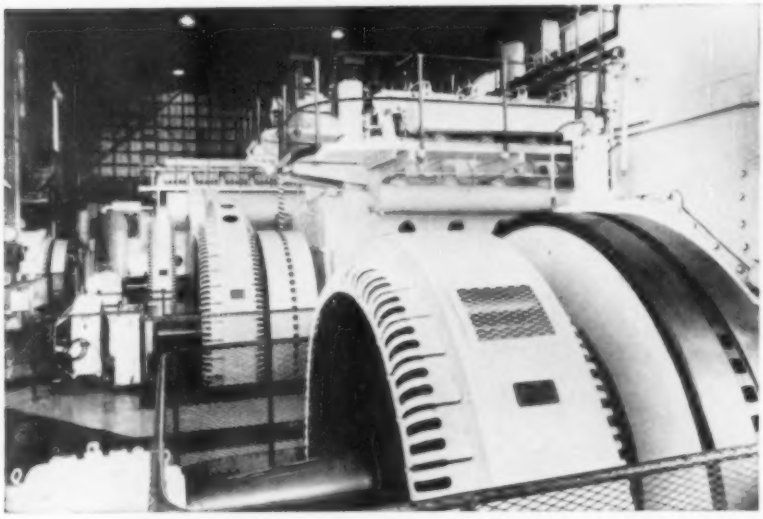
Foreign Products Pipelines

• **Empresa Nacional de Petroleos** (Government of Chile) and **Cia. de Petroleos de Chile (Copec), et al.**
Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.
Status: Under way.
Contractor: **Williams Brothers**
Completion: Early 1958.
• **Israeli Government**
Project: **A 6-in. line from the Haifa refinery to Tel Aviv.**
Completion: Late 1957.
• **Mene Grande Oil Co.**
Project: 60 miles of 6-in. L.P.G. line from Anaco to Puerto La Cruz, Venezuela.
Status: Planned.
Completion: Fourth quarter 1957.
• **North Atlantic Treaty Organization**
Project: 2,000 miles of lines to airfields in parts of Europe.
Status: Under way.
Contractor: **Associated Pipeline Contractors, Inc.** (450 miles from Iskenderun, Turkey to Batman); **TECHINT** (205 miles of 4-in. from Bandirma to Eskisehir, Turkey, and 350 miles of 8-in. from Antalya to Eskisehir)

Foreign Natural-Gas Pipelines

• **Attock Oil Co.**
Project: 60 miles of line from Dhulian field to Rawalpindi in West Pakistan.
Status: Planned.
• **Cuban Gas Transmission Co.**
Project: 650-mile pipeline from Campeche area of Mexico across Yucatan and on the ocean floor to Havana, Cuba; 150 miles would be submarine.
Status: Being studied by Ebasco Services.
• **Gaz de France**
Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris, plus a 10-in. lateral to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.
Status: Under way.
Contractor: French contractors.
Completion: First stage in 1958; complete system in 1960.
• **NIOGAS**
Project: 160-mile, 6, 8, 10, and 12-in. line from Fischamend field to Vienna and other Austrian cities.
Status: Under way.
Contractor: **Williams Brothers and Costain-John Brown.**
Completion: Fall 1958.
• **Petroleos Mexicanos**
Project: 130 miles of 22-in. to parallel 14-in. line from Reynosa to Monterrey.
• **Sui Gas Transmission Co.**
Project: 217 miles of 16-in. from Sui gas field to Moultan, Pakistan.
Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang Magiana, and Montgomery.
Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of Boise, Idaho, and **William Press, Ltd.,** of London.
Project: 145-mile line from Sylhet to Dacca, East Pakistan.
Status: Under consideration. If approved construction could start December 1958.
• **Technical Office of Hydrocarbon, Ministry of Mines and Petroleum, Government of Venezuela.**
Project: 207 miles of 26-in. from Anaco fields to Caracas.
Status: Under way.
Contractor: **Fulghum Contracting Corp.** will be consultants; **Petrogas, S. A.** will engineer and construct the line.
Completion: Spring 1959.
• **Union of Soviet Socialist Republic.**
Project: 808 miles of 26-in. from Stavropol in the Northern Caucasus to Moscow, to serve Voroshilovgrad, Voronezh, Tula, Yelets, and Serpukhov.
• **Yacimientos Petrolliferos Fiscales (Argentina)**
Project: 1,015 miles of 24-in. from Camp Duran to Buenos Aires.
Status: Planned.
Contractor: **TIPSA** (Fish Engineering Corp., Fish Northwest Constructors, Inc., Clark Brothers, North American Utility, Construction International Co.).

Look to COOK for Better Rings!



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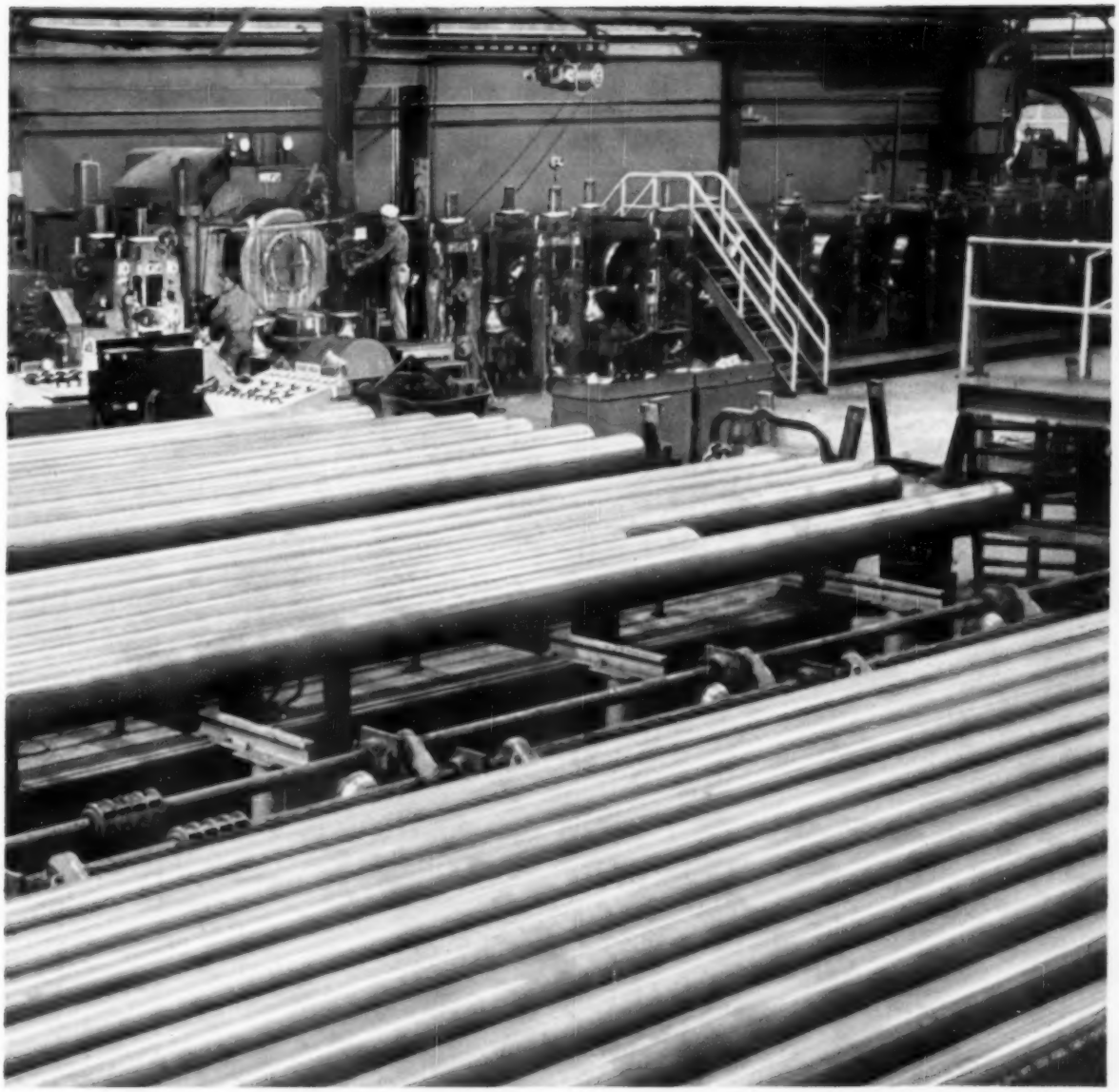

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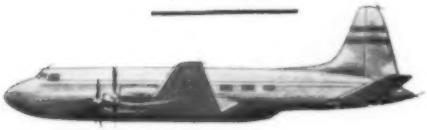

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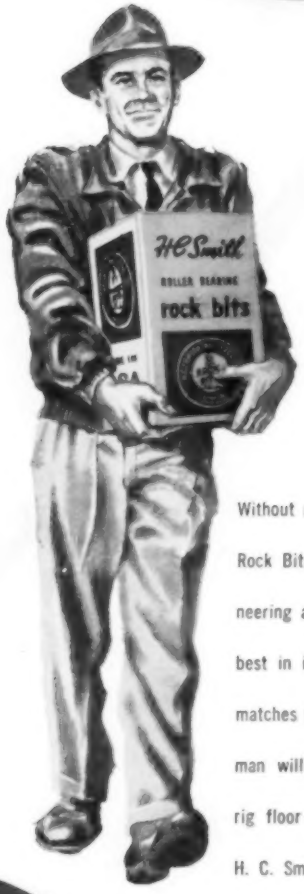

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BRANCHES IN ALL PRINCIPAL OIL CENTERS IN THE UNITED STATES AND CANADA

Among the Drilling Contractors

Longhorn Drilling Corp., Three Rivers, Tex., has contracted for a 6,000-ft. test to be drilled for W. H. McGarr at a wildcat location 4 miles southwest of Batesville, in Zavala County, Southwest Texas. Loaction is for 1 Bartlett, in the Patrick C. Jack Survey.

Globe Drilling Co. is contractor on the 6,500-ft. Woodbine test J. Robert Phillips, Jr., of Dallas, is starting in the J. B. Edwards Survey, 6½ miles southeast of Grapeland, in Houston County, East Texas. The test is on Phillips' Marsh lease.

Cook Drilling Co., Fort Worth, is on a new deep operation in Ouachita Parish, northeastern Louisiana. It is a 9,000-ft. Cotton Valley test for United Producing Co., Inc., of Monroe, La. Location is on United's Ouachita Farms lease in 25-18n-5e, about 2 miles northwest of Crew Lake and about 9 miles northwest of Rayville.

Jones Brothers Drilling Co., Shreveport, is drilling for Wheelock & Weinschel, of Corsicana, Tex., on another deep test in the Colquitt area, 9 miles northeast of Homer, in Claiborne Parish, North Louisiana. The test, 1 Tigner, in 5-22n-6w, about a mile southwest of Cotton Valley production at Colquitt, will be carried to the Smackover formation below 10,600 ft.

Butler-Johnson, Inc., Shreveport, is getting started on a 7,500-ft. wildcat test it has contracted to drill for Francis W. Scott, Shreveport operator, about 2½ miles northeast of Lorelein, in Franklin Parish, northeastern Louisiana. Its location, at 1 Ayer-Chicago Mill, in 9-13n-9e, is about 3 miles southwest of Killens Ferry field, in Tensas Parish, nearest production.

Grady Roper Drilling Co., Lake Charles, is keeping a rig in the South Lake Charles area of Calcasieu Parish, southwestern Louisiana, for another deep well it has contracted to drill for Signal Oil & Gas Co. Latest contract is for 2 Charles Houssiere, Jr., which follows the drilling of 1 Houssiere, now nearing completion.

Bush Drilling Co., Eunice, La., has a rig under contract to Thomas Jordan, Inc., of New Orleans, for an 8,200-ft. wildcat test in southwestern Allen Parish, southwestern Louisiana. It will be Jordan 2-A Industrial, spotted in 29-6s-6w. Location is about 10 miles west of Kinder, 2 miles southwest of Bunchy Creek field, and 2½ miles east of Reeves field.

Beck Oil Co. will drill General Crude Oil Co.'s projected 9,000-ft. wildcat test in northern Jefferson Davis Parish, South Louisiana. Its location, at 1 Langley, in 15-7s-4w, is near the Allen Parish line, about 5 miles southeast of Kinder, in the latter parish, and about 3½ miles northeast of North Edna field, nearest production. Beck now is completing a deep wildcat test about 10 miles north of Kinder which it drilled for its own account.

Conner-Tanner Drilling Co. has a contract for a 6,000-ft. Paleozoic test in northeastern Mississippi's portion of the Black Warrior basin. The test will be drilled for L. O. McMillan. Location is about 6 miles south of Aberdeen, in southern Monroe County. In 34-15s-7e, at 1 Basinger, it is about 4½ miles east of Muldon field, where Union Production Co. has gas and condensate production from the Mississippian-Sanders zone at 5,500 ft.

Nuckolls - Bell Drilling Co., Oklahoma City, has a new contract operation in Cleveland County, Oklahoma. It is an 8,000-ft. Tulip Creek test at 1 Burkett, in 36-8n-2w, a wildcat location south of East Noble field. Drilling is for Weimer & Fitzhugh, of Oklahoma City.

Anschutz Drilling Co., Wichita, Kans., and Denver, will drill a 7,500-ft. Mesaverde test at a wildcat location in eastern Converse County, eastern Wyoming. It is a contract job for El Paso Natural Gas Co. Location, at 1 Ketlesen, in 5-37n-68w, is about 20 miles northwest of Lance Creek field.

Kern Drilling Co., Inc. Magnolia, Ark., is on a new contract job 11 miles east of Dumas, in northern Desha County, southeastern Arkansas. It is a rank wildcat test for Holliman Drilling Co. and E. S. Heyser, Jr., of Dallas. It is listed as 1 Cooke, with spot in 28-9s-2w. Objective is the Eagle Mills formation, expected about 5,600 ft.

Tandem Drilling Co., Camden, Ark., is on a 7,000-ft. Smackover test it has

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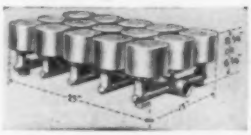

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contracted to drill for Kin-Ark Oil Co., of El Dorado, Ark. Its location, 1 Reynolds, in 15-17s-16w, is east of old Nacatoch production in Lisbon field, 4 miles northwest of El Dorado, in Union County, Arkansas. It is about 2 miles northwest of East Lisbon field's discovery well, nearest Smackover production.

Owen Drilling Co. has taken a 13,000-ft. contract in the East Ellis area, north of Crowley, in Acadia Parish, southern Louisiana. It will drill for Midwest Oil Corp. at 1 Lawson, in 7-9s-1e.

Ocean Drilling Co., New Orleans, is starting another deep test for Natural Gas & Oil Corp. in the East Cameron Block 9 area, in the Gulf of Mexico off the coast of Cameron Parish, Louisiana. It will be the operator's third test in the area. Location is 6,900 ft. southeast of the discovery well, completed last February as a dual-zone gas condensate well from 12,900-ft. and 13,100-ft. pays.

Conroe Drilling Co., Corpus Christi, is contractor on a deal with Katz Oil Co. in the drilling of a 6,000-ft. wildcat test in northeastern Jim Wells County, Southwest Texas. The test, 1 Hubert, in the Casa Blanca Grant, is about 6 miles east of Sandia.

Foster Drilling Co., Richmond, Tex., has a rig working for Sam Harrison at a wildcat location 2 miles north of Longville field, in Beauregard Parish, southwestern Louisiana. Location is for 1 Allen Le Compte, in 24-5s-10w. Plans call for an 8,750-ft. test.

Carnes W. Weaver, Houston, has a new operation for Ada Oil Co. in the Vickers area, 6 miles northeast of Kountze, in Hardin County, Texas Gulf Coast. Location, at 2 Emma Sternenberg, is southwest of a Yegua oil-discovery well (1 Emma Sternenberg) completed by Ada last January. The latter well produces from a 6,875-ft. pay. The new operation is set up to go to 7,750 ft.

Mallard Well Service Co. has taken a 5,000-ft. drilling job in Napoleonville field, Assumption Parish, southeastern Louisiana. The well, 1 Armelise, is for Sterling E. Little. Location, in 43-12s-13e, is on the east side of the dome.

Jack Halbert Drilling Co., Tyler, Tex., is getting under way on a 5,500-ft. Woodbine test it has contracted to drill for Union Producing Co. southwest of North Jacksonville field, in Cherokee County, East Texas. Location, listed as 1-A Thurman, is about 5 miles north of Jacksonville, in the Thomas Quevado Survey. It is about 1½ miles from production.

Jordan Drilling Co., Kilgore, Tex., is about down on the first of two confirmation tests it is under contract to drill for Texkan Oil Co., of Dallas, in the new Agnes field, south of Slocum, in southern Anderson County, East Texas. The drilling well, 1 Wallace-Caskey Unit, is about a quarter mile southeast of Texkan's discovery well, completed last May with gas-condensate production from a 5,875-ft. Woodbine sand. Location of the other test, 1 Killion-Leatherwood Unit, is about ¾ mile southwest. Permits are for 6,200-ft. tests.

E. D. Markham, Shreveport, is drilling another 3,000-ft. Travis Peak test for William Wood, Jr., of Marshall, Tex., about 4 miles south of Marsden, in southwestern Bradley County, Arkansas.

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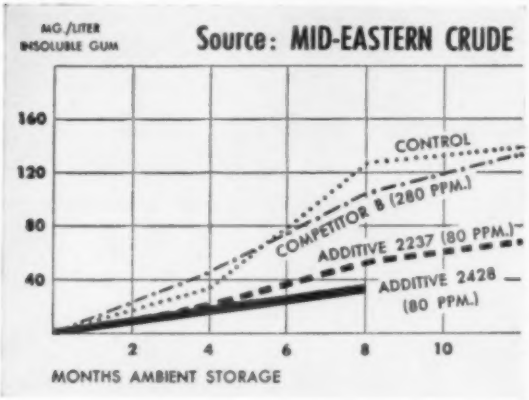
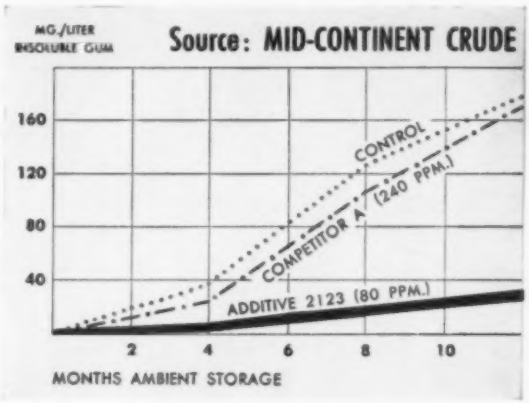
Four fuel oil stocks (West Texas, Mid-Continent, Venezuelan and Middle East types), have been subjected to 12 months ambient storage conditions using 41 potential additives. These 41 additives resulted from the screening of over 300 chemicals. Four Armour products (3 graphically shown below) were outstanding in their ability to inhibit and/or solubilize gum and stabilize against radical color change. In addition, most effective for West Texas crudes was Armour Additive #2528; for Venezuelan crudes, Additive #2237.





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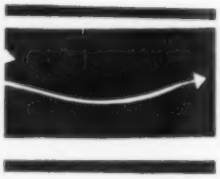

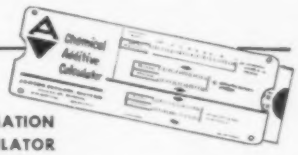

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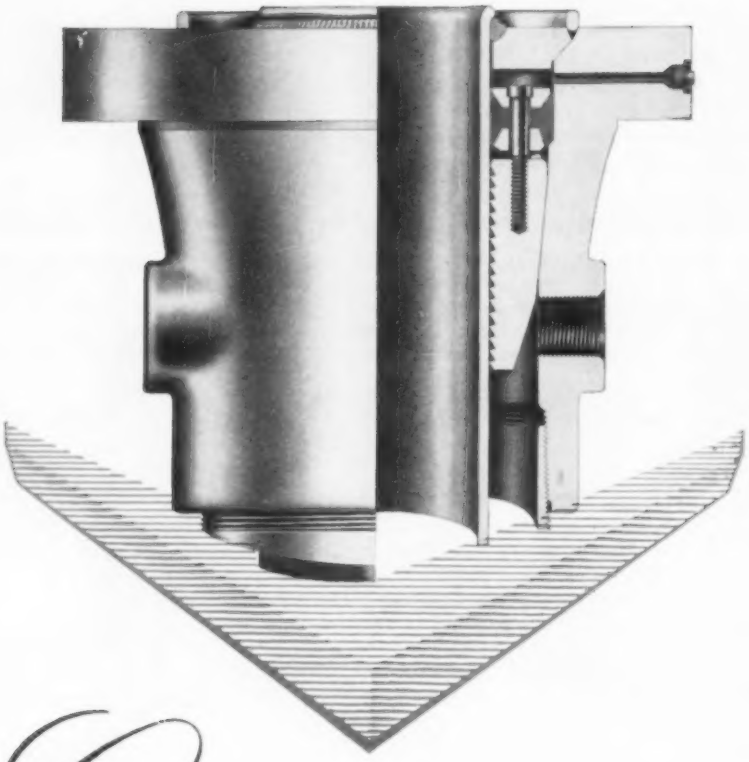

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The trailer is fabricated entirely of special formula 808 steel with a full 18" deep frame and 9" outer rail. Designed for three-point stability in nose loading – has oversize rolling tail pipe with self-aligning bushing for rear loading.

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Dear Mr. Street:

We started using your pumps back in 1937 and have continued to do so to the present time. We now have one HP-8000 and one HP-14000 in operation, which we believe is the most economical pump on the market to operate today.

The above two pumps have been in operation for several years, with practically no cost to us at all.

We operate the two rigs in North Texas area and drill contracts, interest deals, and our own account from 2000 to 7500 feet.

Yours very truly,

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Partner

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Currently in use by K&H are Wheland HP-8000 and HP-14000 Pumps:

". . . in operation for several years with practically no cost to us at all."

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On location in North Texas, the Wheland HP-8000 pump which has performed so well for K&H Drilling Co.

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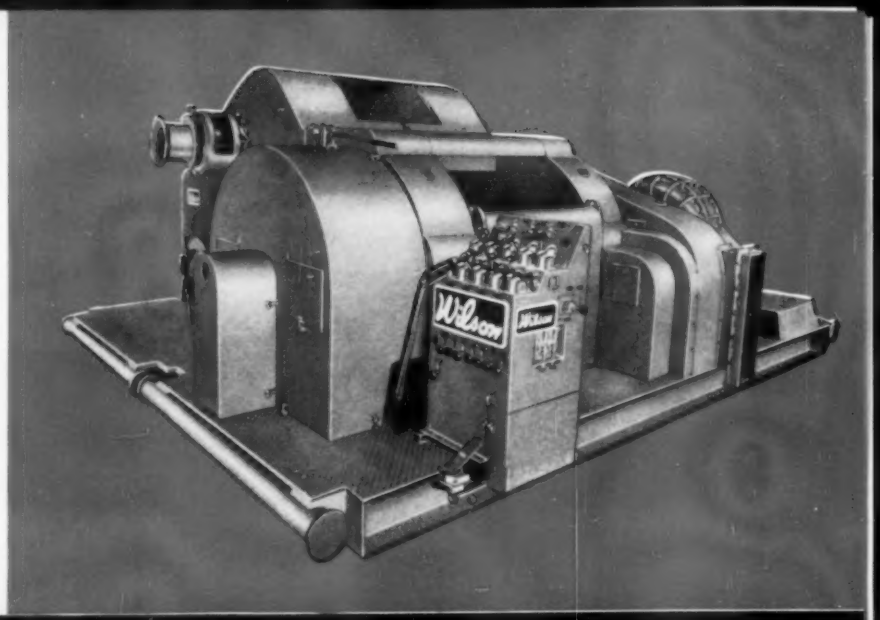

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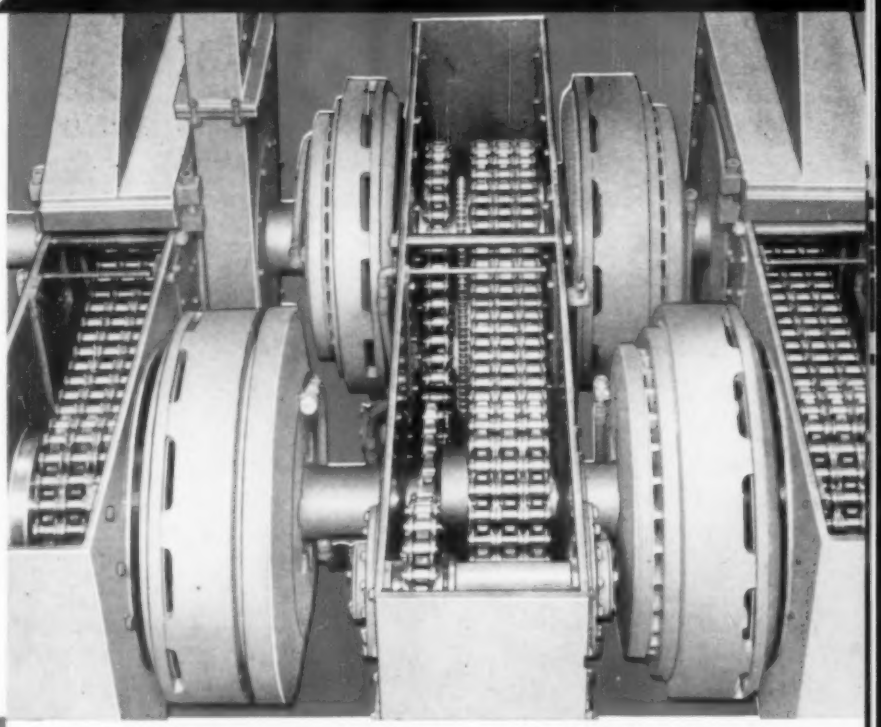

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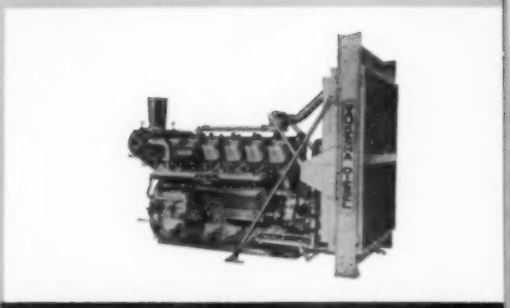

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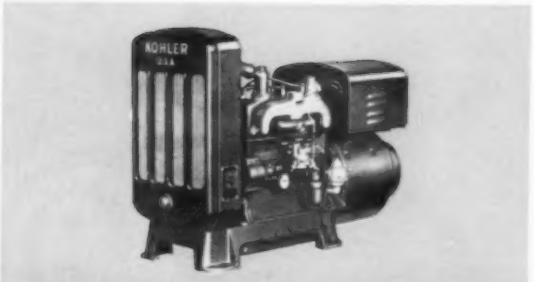

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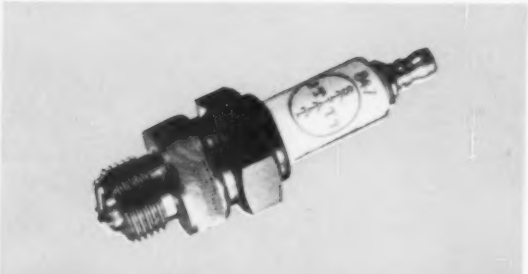

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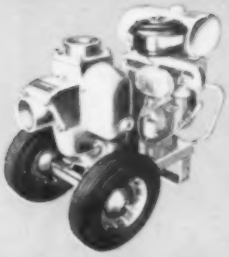

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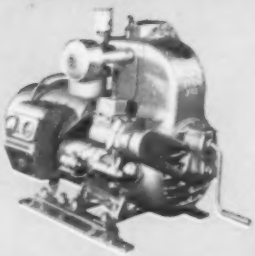

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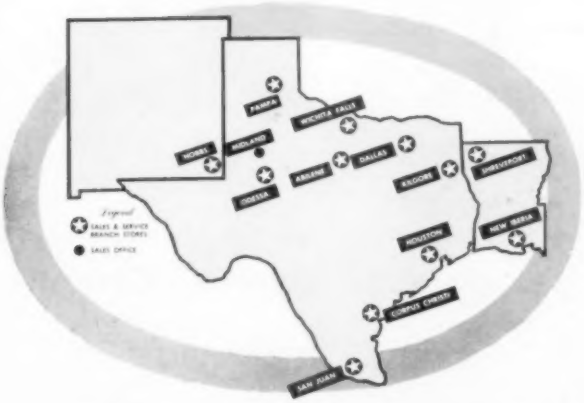

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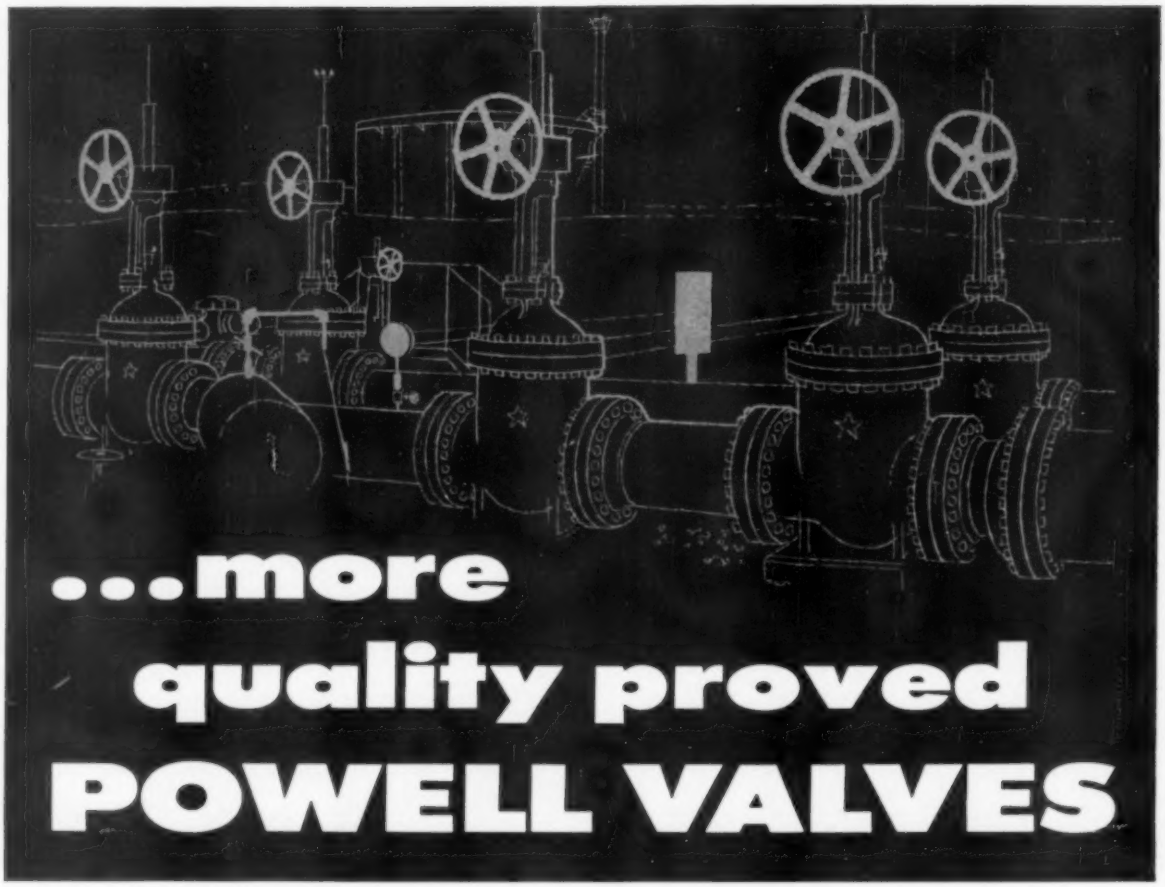

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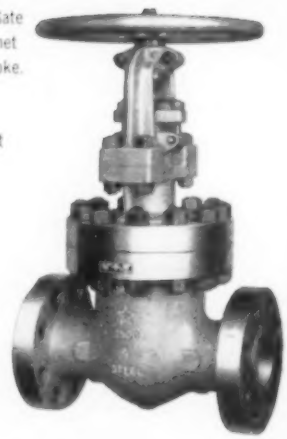

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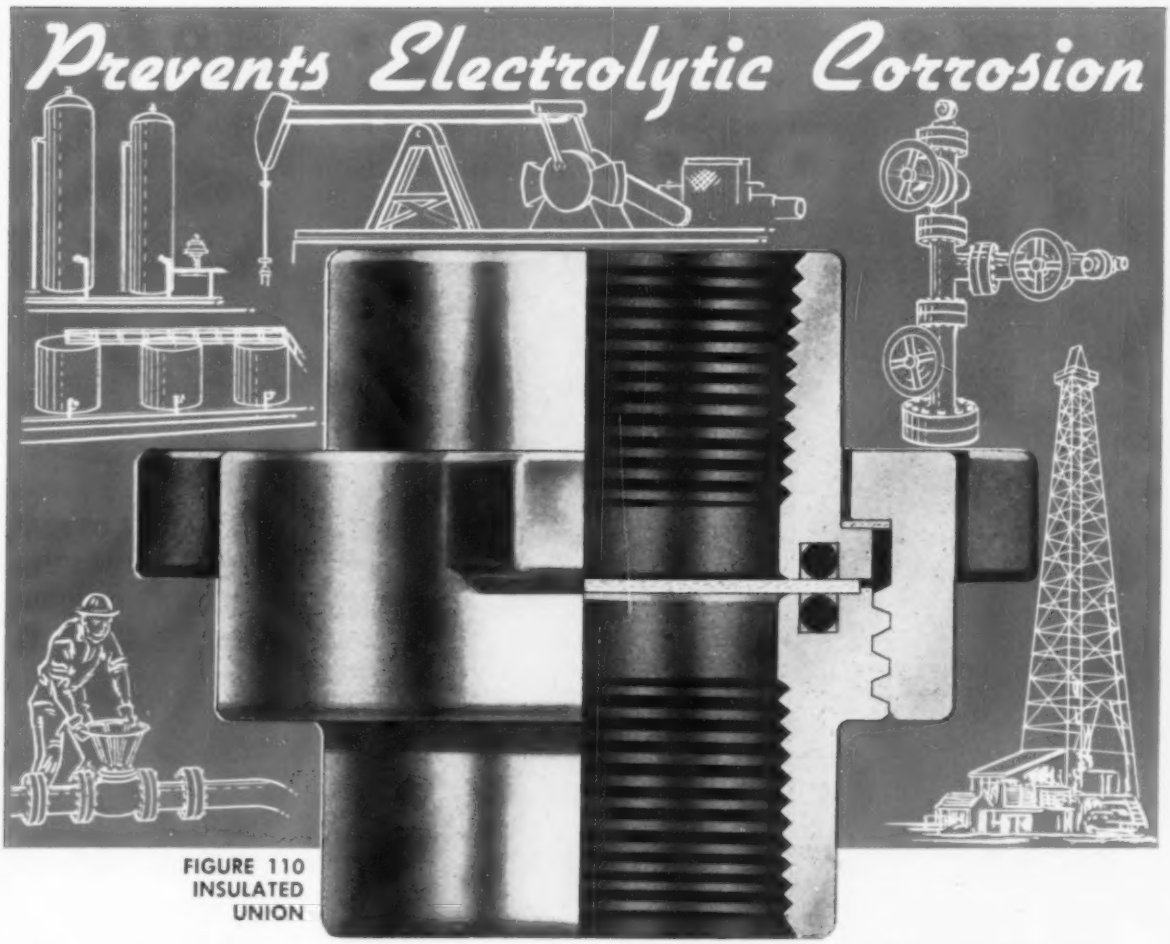

FIGURE 110
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RESISTANCE TEST

Size	Volts Impressed	Resistance at Start—ohms	Resistance at End—ohms	Variation in resistance during time voltage was impressed (1 minute)
¼"	1,000 D.C.	11,000,000	11,000,000	None
2"	1,000 D.C.	30,000,000	30,000,000	None

BREAKDOWN TEST

Size	60 cycle Breakdown Voltage	Location of Breakdown	Damage to Insulating Material
¼"	1,500 RMS	Air gap between mating parts	None
2"	3,500 RMS	Air gap between mating parts	None

*By R. R. Crookston & Associates. Certified copies upon request.

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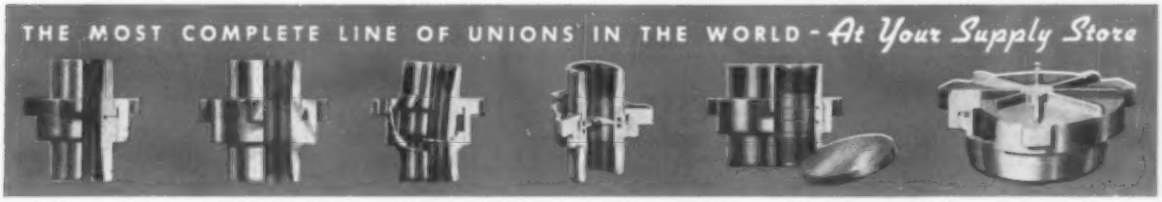

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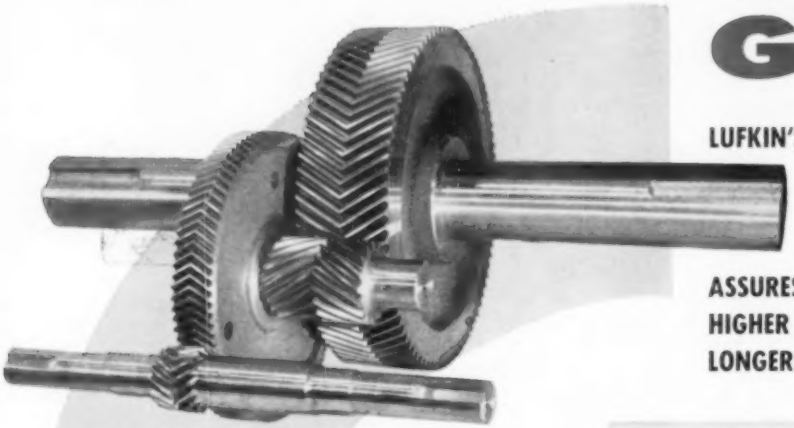

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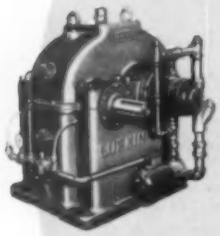

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"precision" means . . .

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Fact 2

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The Ridge Tool Company, Elyria, Ohio, U. S. A.

7 YEARS WITHOUT OVERHAUL

Since he installed a "Jimmy" Diesel

How's this for a steady on-the-job record? Olin Sharp, of Evansville, Indiana, reports that after seven years' operation, with frequent moves, his two General Motors Detroit Diesel "Twin 6-71's" still give "like-new" performance. He says, "Their fast acceleration reduces lost time in making round trips and the low operating costs mean savings to us."

GM Detroit Diesel 2-cycle engines are powerful—pull more pipe—pump more mud—make more hole. They are compact—can be moved quickly and easily from one site to another. They can be depended on to get the job done fast without costly downtime. And they are promptly serviced by GM Detroit Diesel distributors and dealers everywhere.

Single and multiple engine units are available in a wide horsepower range for almost any petroleum application. Write us or ask your nearest GM Detroit Diesel distributor for new 16-page illustrated catalog "GM Detroit Diesel Petroleum Engines." It will help you choose the right power for *every* oil field job.

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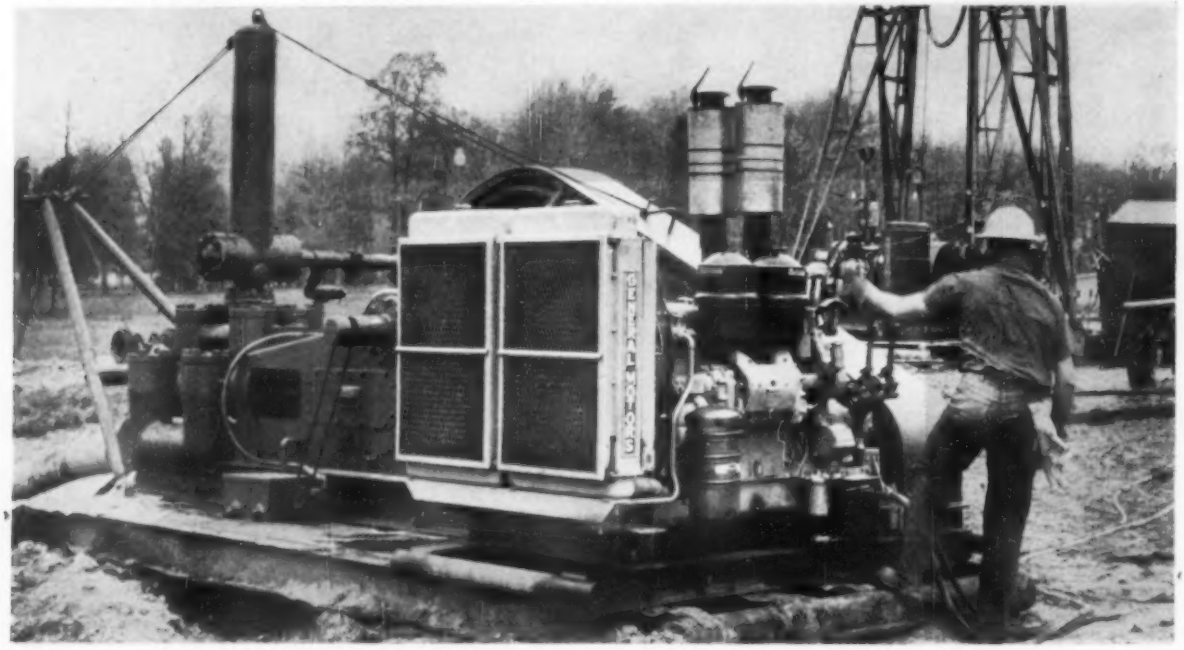
DETROIT DIESEL

Engine Division of General Motors, Detroit 28, Michigan

REGIONAL OFFICES: New York, Atlanta, Detroit, Chicago, Dallas, San Francisco

Now—more than ever—it pays to standardize on GM Diesel—available in 1485 applications of power equipment built by more than 175 manufacturers

Two GM "6-71" Diesel Twins, drive Ideco draw works and Gardner-Denver pump, for Sharp Drilling Co., Evansville, Ind.



ALABAMA—Birmingham, Montgomery
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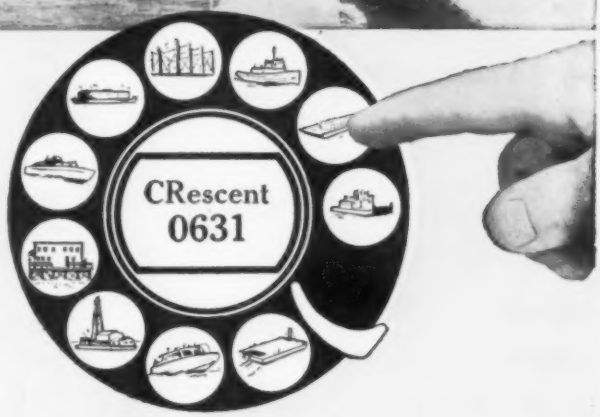
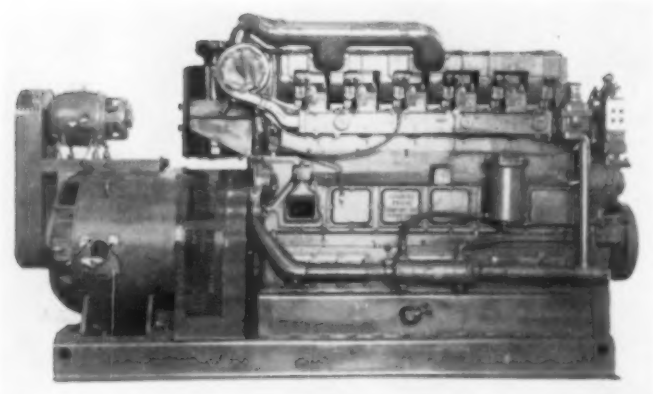


SHOWCASE...

NEW EQUIPMENT



Turbodiesel Engine Developed for Pumps

Here's a new 450-hp. engine for driving pumping units, drilling rigs, and electric generators. It's the Cummins LRT-6.

The engine is expected to meet a power need in oil-field and other applications, where high-horsepower, high-torque engines are required, the maker reports. It uses normally wasted energy of exhaust gases by means of a turbocharger to develop additional horsepower.

A turbine located in the exhaust system drives a centrifugal blower in the air-intake system. By forcing a greater weight of air into the cylinders, more fuel can be burned completely and more power developed.

The LRT-6, rated at 450 hp. at 1,100 r.p.m., has a displacement of 2,477 cu. in. **Write or call: Cummins Engine Co., Inc., Columbus, Ind., for details on LRT-6 engine.**

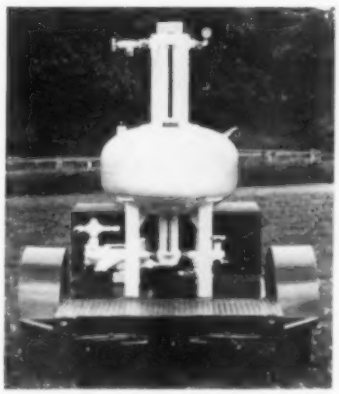
●

Steam Hose Designed For Refinery Use

Here's a new steam hose designed especially for use by oil refineries, the maker announces. The hose is covered with Neoprene rubber which is considered oil, weather, and age resistant.

Called Flexsteel 150 refinery, the hose is made with a steel-wire braid in three sizes: ½, ¾, and 1-in. i.d. It's designed for saturated steam at a maximum working pressure of 150 psi. **Write or call: Goodyear Tire & Rubber Co., Akron 16, Ohio, for details on Flexsteel 150 refinery hose.**

●



L.P.G.-Liquid Meter Prover Now Available

Now commercially available is this L.P.G. liquid meter prover, This prover, operating on the volumetric principle, is composed of an A.S.M.E. vessel designed for 250 psi. Integral upper and lower gage glasses are provided to determine the starting or zero point on the lower glass and the reading of the total gallonage delivered into the prover on the upper gage glass. A total of 53 gal. of L.P.G. are delivered into the prover for testing the meter.

Graduated scales are provided on the gages to determine the variations of the metered input and to allow checks against established tolerances.

Charts for correcting gage readings for temperature and pressure, testing procedures, and forms for recording data are being prepared for publication by the National Bureau of Standards, the maker reports.

The prover is equipped with all necessary relief valves, pressure gage, excess-flow check valves, shutoff valves, thermometer well, levels for establishing levelness of unit, strainer, wire braid flexible connections, extra-heavy pipe, forged-steel pipe fittings, and hose

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Described in OIL AND GAS JOURNAL - Issue of October 14, 1957

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ADDRESS.....

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connections for efficient and safe operation, the maker reports.

An electrically operated L.P.G. pump with 100 ft. of extension cord is included for evacuating the prover back to the supply tank. Hoses for vapor equalizing and evacuation are provided. **Write or call: Pressed Steel Tank Co., Milwaukee, Wis., for details on L.P.G. liquid meter prover.**

•

Aerial Pipeline Markers Are Easily Seen From Air

These new aerial pipeline markers are easier to see than present types, according to the maker. They are available in a variety of shapes with the numbers mounted either horizontally or at an angle up to 45°. The angle types may have the numbers on one or both sides, for ready visibility from either direction.

The markers are made of heavy-gage steel. They have black numerals on the internationally accepted orange background. They are available with either enameled or porcelained surfaces and numbers or a combination of porcelain numbers and enameled surfaces.

The signs are easily attached to upright standards or pipe by U-bolts furnished with the markers. **Write or call: Gleason Romans Pipe Line Patrol Co., P. O. Box 8447, Tulsa, Okla., for details on aerial pipeline markers.**

•

Solid-Film Lubricant May Solve Problems

Lubrication for temperatures ranging from —300° to +1,500° F. is possible with this new coating, the maker claims. The dry-film lubricating process reportedly is chemically inert and will withstand pressures in excess of 200,000 psi.

The maker points out it can be used to lubricate oil tools, oil-production equipment, and petrochemical processing equipment where conventional lubricating is impossible or ineffective.

The process, developed for the air-

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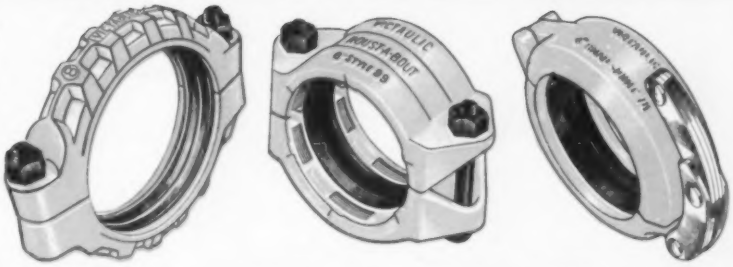
METHOD OF PIPING

VICTAULIC HAS EVERYTHING...

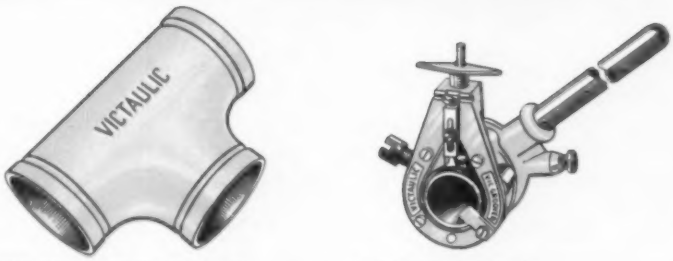


VICTAULIC COUPLINGS
Simple, fast, reliable. *Styles 77, 77-D,* for standard uses with steel or spiral pipe, — *Style 75* for light duty. Other styles for cast iron, plastic and other pipes. Sizes ¾" to 60".

ROUST-A-BOUT COUPLINGS
For plain or beveled end pipe *Style 99.* Simple, quick, and strong. Best engineered and most useful plain end coupling made — takes a real "bull-dog" grip on the pipe. Sizes 2" to 12".

VICTAULIC SNAP-JOINTS
The new, boltless, speed coupling, *Style 78.* Hinged into one assembly for fast piping hook-up or disassembly. Hand locks for savings in time and money. Ideal for portable lines. Sizes 1" to 8".

COUPLINGS FOR EVERY PIPING JOB



VICTAULIC FULL-FLOW FITTINGS
Elbows, Tees, Reducers, Laterals, a *complete line*—fit all Victaulic Couplings. Easily installed — top efficiency. Sizes ¾" to 12".

VIC-GROOVER TOOLS
Time saving, on-the-job grooving tools. Light weight, easy to handle — operate manually or from any power drive. Sizes ¾" to 8".

PLUS FITTINGS AND GROOVING TOOLS

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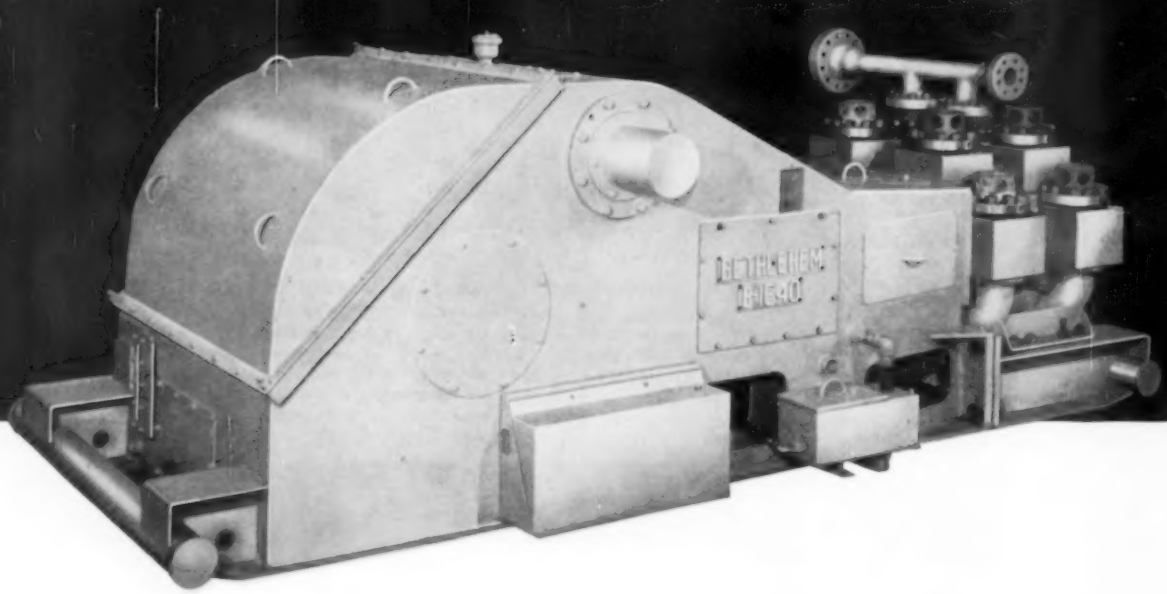
And now the champion... the B-1640



After more than a decade of research in laboratory, shops, and field, Bethlehem presents the B-1640 slush pump—a mighty unit suitable for the deepest jet drilling yet planned. It is large and powerful enough to achieve unaided the desired rates of penetration, thereby eliminating the need for parallel and series operation of mud pumps.

In the heavyweight class, the B-1640 pump is unquestionably the champion. It is designed and built to do an outstanding job in this era of deep, deep holes and rapidly mounting exploration costs.

This is a pump that is necessarily rugged in every detail. The power-end frame is fabricated from heavy steel plate and steel castings; the box section thus formed resists deflections and maintains alignment of all components. Gears, shafts, and connecting rods are sturdy steel forgings. Large antifriction bearings, capable of absorbing tremendous loads, are used throughout. The husky crankshaft assembly is properly counterweighted to reduce unbalanced forces to a minimum.

The fluid end, too, is exceptionally rugged. Instead of the usual cast type, Bethlehem employs a forged-steel fluid end in the B-1640. Studding conforms to the API-ASME Code for Unfired Pressure Vessels —a regular feature of all Bethlehem slush pumps.

The B-1640 is a companion piece to Bethlehem's B-3661 drawworks. You are invited to inspect both units at leisure—and to study the engineering data pertaining to each. It is our belief that you will never be satisfied with anything less for your extra-deep drilling jobs.

BETHLEHEM SUPPLY COMPANY

General Offices: 21 E. Second St., Tulsa, Okla.

West Coast Headquarters: Los Angeles, Calif.

Canadian Distributor: Bethlehem Supply Company of Canada, Ltd. Calgary, Alberta, Canada

Export Distributor: Bethlehem Steel Export Corporation 25 Broadway, New York, N. Y.

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New Equipment

craft and missile industry, has only recently been released for industrial use. The coating, called Teclube, consists of laminar solids and soft metals selected and compounded with thermosetting resins. **Write or call: Coating, Inc., P. O. Box 1831, Houston 1, Tex., for details on Teclube solid lubrication.**

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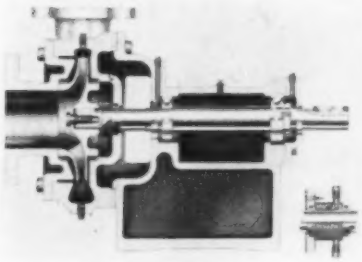


Centrifugal Pump for General Water Service

Here's a new high-speed, high-head centrifugal pump for general water service. The Model BH pump comes in four sizes. These are: (1) a 1-in. model with capacities to 150 g.p.m., (2) 1½-in. model with capacities to 220 g.p.m., (3) a 2-in. model with capacities to 440 g.p.m., and (4) a 3-in. model with capacities to 520 g.p.m.

All perform at high efficiency over a wide range of service conditions, the maker claims. Their features include stainless-steel shafts, oil-lubricated ball bearings, mechanical seals, and hydraulically balanced bronze impellers. **Write or call: Gardner-Denver Co., Quincy, Ill., for details on Model BH pump.**

•

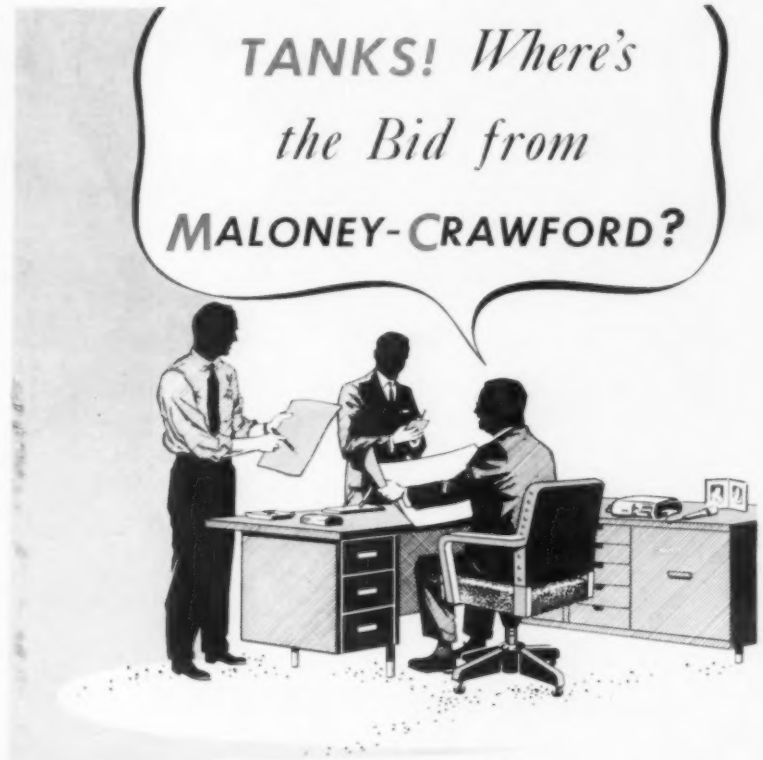
Tire Type of Tractor Travels Over Most Terrain

Rough, sandy, soggy, or steep terrain can be readily traversed with this new vehicle, the Terra-Tire tractor, the maker claims. It's easy to maneuver under all kinds of weather and ground conditions. And its drawbar pull is 2,450 lb.

The tractor weighs about 2,800 lb. The tires have a 24-in. diameter. Air pressure is 5 psi. in the front tires. These tires are unpowered and individually suspended. The rear tires are powered through a locking differential. Their air pressure is 7 psi.

A high clearance plus hydraulic power steering and walking-beam construction of the front-tire suspension system permits the tractor to operate over rocks and obstacles, the maker says. These features also provide firm traction and smooth-riding. The wheelbase is 80 in. long, with 44-in. tread centers. The turning circle has an 11-ft. radius. Equipped with a transmission giving four forward speeds and one reverse, the vehicle obtains a maximum speed of 13.2 m.p.h.

Made of welded-steel structural tubing and equipped with nonskid decks, the frame is easily adaptable for special rigging to support pipe-laying or other equipment. **Write or call: Atwood Vacuum Machine Co., Rockford, Ill., for details on Terra-Tire tractor.**



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SHOWCASE . . .

New Literature

Electro-Hydraulic Valve Operator Needs No Amplifier

According to the maker, this new self-contained electro-hydraulic valve operator produces high performance without the use of electronic amplification by using only simple d.c. actuated force motors to operate the hydraulic pilot.

Nozzle - flapper combinations are used in the pilot to control hydraulic pressure. This is said to eliminate sliding plate or spool type of valves which are easily stuck.

The operators may be adapted to operate on the d.c. input signal from any instrument currently available, the maker states. **Write or call: Fisher Governor Co., Marshalltown, Iowa, for details of electro-hydraulic valve operators.**

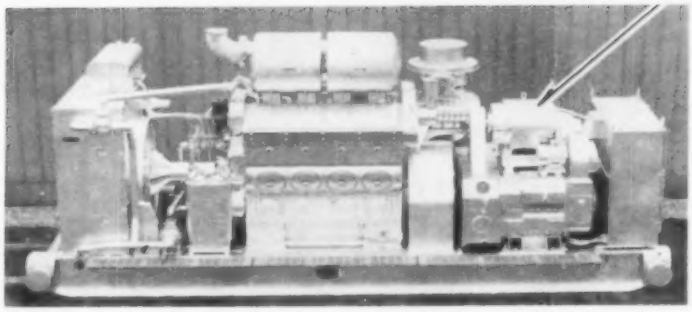
●

Pipeline Filters Provide Large Filtering Surface

An advantage cited for this filter is that no tools are required for servicing. Made with bores of 2 to 8 in., the filter has a 300-psig. working pressure and comes in simplex and duplex types.

Made in England, the filter handles all liquids, the maker states. Its body and cover are of shot-blasted cast iron.

The filter surface is reportedly over 12½ times the pipe area. This feature permits long periods between cleaning and causes little pressure drop, the maker says. **Write or call: Plenty & Son, Ltd., Eagle Iron Works, Newbury, England, for details on filters.**



D.C. Generator Also Supplies A.C. Power

Other sources of electric power for drilling rigs aren't needed with this new d.c. diesel-electric generating unit. It has a built-in. a.c. generating system for auxiliary electric power.

Designated the SR-10, its generator rating is 640 kw.

A load regulator automatically provides the load demand without overloading the engines, according to the maker. **Write or call: Electro-Motive Div., General Motors Corp., LaGrange, Ill., for details on SR-10 diesel-electric generator.**

Electronic Device Speeds Surveying

Measurements of distance and a number of other surveying tasks can be quickly accomplished under all reasonable weather and terrain conditions with this new portable electronic-measuring instrument, according to the maker. Called the Tellurometer, the device makes use of microwaves to permit accurate operation for all normal survey tasks in daylight or dark, in fog, mist, and even light rain, and, under limited conditions, light brush and timber.

The instrument's minimum effective range is about 500 ft. Its maximum range varies from 30 to 50 miles. This depends upon the line-of-sight conditions. **Write or call: Tellurometer, Inc., 1346 Connecticut Avenue, N. W., Washington, D. C., for details on Tellurometer.**

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to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

NAME AND/OR MODEL NUMBER.....

.....

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Described in The OIL AND GAS JOURNAL - Issue of **October 14, 1957**

NAME.....TITLE.....

COMPANY.....

ADDRESS.....

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DATE.....

Anti-lock prevents relative rotation between anchor cage and tubing while running

Re-latch threads prevent upper slips from setting until ready.

Long, flexible drag springs allow easy recovery in case of washover.

Special seal protects against fouling from sand or scale.

Internal shoulder creates a differential piston inside rubber to cause a tighter seal.

Full setting force is transmitted to packing element through lower head. No scrubbing action between lower slips and casing wall during setting stroke.

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permanent completion

TYPE A DRILLABLE PACKER

runs and sets easily, quickly

- ***Built-in safety against premature setting***
- ***Set and produce in ½ tubing trip***
- ***Unequalled rubber seal***

Guiberson Type A Drillable Packer gives you a versatile packer for many uses..single or multiple zone production, acidizing, pressuring operations, water-flooding, testing, corrosion control and many others.

New safety factors against premature setting are provided since the transmitting of drag from tight casing or impact from junk is direct to the tubing string.

The Type A can be set and placed in production with only ½ tubing trip. Spacing problems are easier, especially when run in combination with a multiple zone packer. From rig floor to completion, the Type A runs and sets faster than any other permanent packer.

Guiberson superior quality rubber and special lead-alloy thimbles compress fully for a leak-proof seal. Setting is quick, easy and uncomplicated..may be set by wire line. Available in 5" through 7⅝" sizes for 2" or 2½" tubing with a full line of stingers and accessories. Ask your Guiberson representative for a recommended installation or write for full details.

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SHOWCASE . . .

New Literature

Pump Application Chart. Now available is this new catalog data sheet which contains a handy model selector chart designed to help oil-well drillers, as well as oil-exploration, pipeline, and transportation companies choose the right Barnes pump for a specific application. The data sheet gives heads, capacities, and other useful information on pumps used in oil-field and pipeline applications. It covers gasoline, electric, diesel, and belt-driven pumps (including diaphragm, standard, and self-priming models) used in oil transportation and storage, sludge and slurry handling, watering, dewatering, pressure testing, and fire-protection applications. **Write or call: Barnes Mfg. Co., Mansfield, Ohio, for Data Sheet 342.**

•

Engineering Applications of the Datatron electronic data processing system to pipeline design are set forth in new Brochure 5-03-110. The eight-page brochure considers the optimum design of a natural-gal pipeline as an example of a Datatron computational process. The brochure describes how the computer completes, in 1.4 seconds, the calculations involving one pipe segment or compressor-station design. **Write or call: Electro Data Div., Burroughs Corp., 460 Sierra Madre Villa, Pasadena, Calif., for Brochure 5-03-110.**

•

Process Moisture Monitor, the CEC Type 26-310, is detailed in a new four-page data sheet. After describing how the process moisture monitor is designed for continuous in-plant moisture measurement of process streams, the data sheet lists a number of applications and then explains the principle of operation employed by the instrument. It closes with a table of specifications. **Write or call: Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif., for data sheet on Type 26-310 moisture monitor.**

•

Process Chromatograph for remote control and recording, continuous operation, automatic sampling and programing of recorded data and providing precise regulation of temperatures and carrier flow is set forth in new CEC Bulletin 1836A. The 10-page bulletin tells how the chromatograph works and details its ability to maintain constant operating parameters. Additionally, the bulletin lists the unit's specifications. **Write or call: Consolidated Electrodynamics Corp., 300 North Sierra Madre Villa, Pasadena, Calif., for Bulletin 1836A.**

•

Air-Engineering Data File (Bulletin E-57) covers engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. It includes helpful tables for estimating air-handling requirements, entrance and elbow losses, and duct sizes. It also includes specifications for propellers, coatings, and motors, along with corrosion-resistance and temperature guides, physical fan laws, terms, and definitions. **Write or call: Aerovent Fan Co., Inc., Piqua 84, Ohio, for Bulletin E-57.**

•

Piant Facilities of Chicago Steel Tank Co., custom fabricators of process equipment and pressure vessels are presented in a new 32-page color brochure. This booklet is expected to be of special interest to design engineering and other equipment-buying persons in the process industries. Personal inspection of the firm's facilities, often impractical due to time and distance, can now be accomplished through the pages of the brochure. It describes all major

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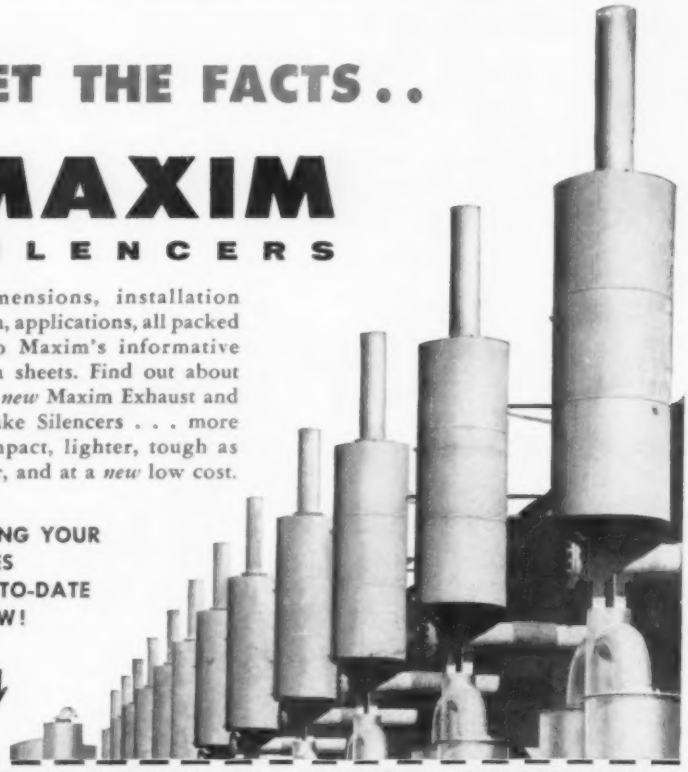

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Drillers' records *prove* that Diamond Roller Chain costs less to use. It lasts longer. It is more dependable. It eliminates costly downtime.

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Please refer to the classified section of your local telephone directory under the heading CHAINS *or* CHAINS-ROLLER

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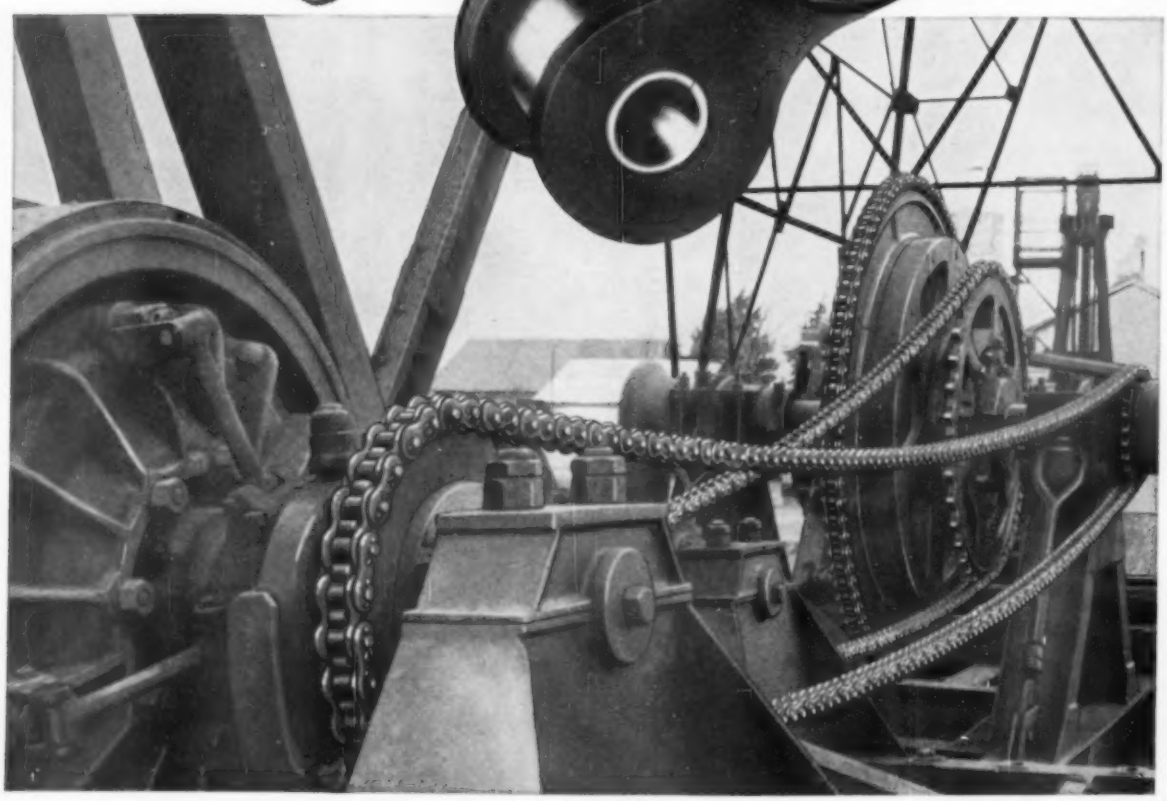

fabricating equipment and its capacities for thickness, length, width, and tonnage. Also, it explains the complete testing and shipping facilities. Special sections are devoted to engineering, material layout, alloy equipment, forming and dishing, joining of sections, welding, and finishing. **Write or call: Chicago Steel Tank Co., 6400 West Sixty-sixth Street, Chicago 38, Ill., for brochure on plant facilities.**

●

Pedestal-Mounted Lifting Cranes for offshore supply craft are featured in a new six-page Link-Belt folder. Called Sea-Cranes, the machines have rated lifting capacities of 12½ to 35 tons. They feature a fingertip-operated, power hydraulic-control system. The system provides fast, positive, and safe control with greatly reduced operator fatigue, according to the folder. **Write or call: Link-Belt Speeder Corp., 1201 Sixth Street S. W., Cedar Rapids, Iowa, for Book 2316.**

●

Sectional-Drive Groups for Consolidated Drilling Rigs are the subject of new National Supply Bulletin 472. The bulletin includes features and specifications of the Type B-1 ¾ quad-series drive group. This group was designed specifically for engines rated above 525 hp. using hydrodynamic drives and mud pumps at a 1,000-hp. input. **Write or call: National Supply Co., 2 Gateway Center, Pittsburgh, Pa., for Bulletin 472.**

●

Gas Generators. Here's a new four-page, two-color folder describing three basic types of gas generators—endothermic, exothermic, and nitrogen. The folder includes a helpful table on the application of gas generators in eight major processing industries. Illustrations of alumina regenerative dryers and refrigerated gas coolers are included too. **Write or call: A. A. Straub Co., Inc., 4930 Grayton Road, Cleveland 11, Ohio, for folder on gas generators.**

●

Inspection of Wire Rope, methods of lubricating wire rope, use and abuse of wire rope, and sheave maintenance are some of the subjects covered in the new Macwhyte Wire-Rope Manual G-16. In addition, sections of the manual give strengths and weights of wire rope, cable assemblies, and rated capacity of slings. Designed as a complete reference guide on the care and use of wire rope and slings, the manual is in handbook size (5 by 6½ in.) and tab indexed for quick reference. **Write or call: Macwhyte Co., 2908 Fourteenth Avenue, Kenosha, Wis., for Manual G-16.**

●

Hydrostatic Pipeline-Testing equipment and services of Williams Pressure Service Co. are set forth in a new multicolor four-page folder. The folder explains how the company programs each job and minimizes testing time. At the end of the test, it provides final reports including a complete description of the testing program, summary of results, acceptance-test reports, pressure charts, and a copy of daily logs. **Write or call: Williams Pressure Service Co., 2000 Beck Building, Shreveport, La., for brochure of services.**

●

Wire-Line Valve for use while running wire-line equipment is detailed in a new four-page brochure. According to the brochure, the valve is light and safe. It features a pressure seal that needs no adjustment or lubrication. And the valve reportedly affords pressure control during wire-line operation emergencies without having to cut the wire line. Tables list specifications, prices, and parts. **Write or call: Bowen-Itco, Inc., P. O. Box 4587, Houston 13, Tex., for wire-line valve brochure.**

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compound pressure gauges

THE ULTIMATE IN QUICK EASY CHECK OF PRESSURE AND PRESSURE CHANGES

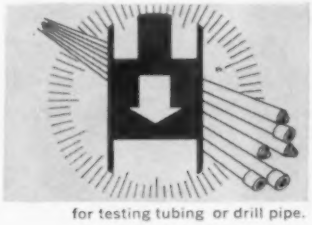
THE VERNIER POINTER
Makes 4 complete revolutions for the full scale of the gauge giving *greater sensitivity* and much *easier reading with the same accuracy.*

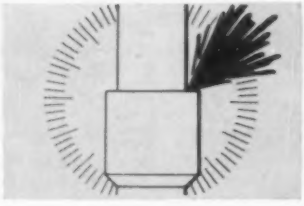
THE STANDARD POINTER
Makes one revolution for the full scale of the gauge with typical Martin-Decker accuracy and dependability.

Compound Pressure Gauges Available In:

4,000 lbs.	8,000 lbs.
12,000 lbs.	16,000 lbs.

for fracturing or cement squeeze jobs.


for testing tubing or drill pipe.


for detecting drill pipe leaks.

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EQUIPMENT MEN . . . in the News

National Supply Appoints Crawford Division Manager

W. D. CRAWFORD

William D. Crawford has been appointed division manager of the eastern division of National Supply Co. He succeeds Roger L. Dailey, who died September 4, 1957.

In his new position Crawford will be responsible for supervision of the company's oil-field and water-well stores in Illinois, Indiana, Kentucky, Ohio, Michigan, and West Virginia, with headquarters at Toledo.

Crawford joined the company in 1938 as a clerk in the Clay City, Ill., store. He was promoted to a district managership in 1954, serving most recently in the Michigan-Ohio-Pennsylvania district, with headquarters at Wooster, Ohio.

Oil Center Tool Announces Several Personnel Changes

A number of important personnel promotions and changes have been made by Oil Center Tool Co., according to C. Ross Spencer, sales manager.

C. T. JONES

JACK NORTON

C. T. Jones has been made assistant sales manager with headquarters in Houston. Jack Norton has been promoted to manager of export sales, also with headquarters in Houston.

Jones has been manager of the West Texas-New Mexico district with offices in Midland, Tex., for 5 years. Norton has been manager of the North Texas-Oklahoma district. He worked with major supply companies for several years before joining Oil Center Tool.

Replacing Jones in the West Texas-New Mexico district is A. C. West, Jr., and A. M. Taylor replaces Norton in the North Texas-Oklahoma district. At the same time, headquarters of the North Texas-Oklahoma district have been moved from Dallas to Oklahoma City.

Jim Humphries has been transferred from Houston to handle city sales in the North Texas area with offices in Dallas. B. C. Johnson, warehouseman at Corpus Christi, has been shifted to Houston as serviceman and W. E. Chiasson, warehouseman at Lafayette, La., is shifted to Houma, La., as sales representative. LeRoy Jensen is now sales representative in Laurel, Miss., and Jim Simmons is sales representative in Shreveport, La.

Tubular Lining Makes K. W. O'Connor Regional Manager

Kenneth W. O'Connor has been appointed southern Texas regional sales manager by Tubular Lining Corp., Houston processor of plastic linings for oil-field tubular goods. Since joining Tubular Lining in January of this year, O'Connor has been employed in the company's training program in production, research, and office procedures. His previous experience includes work as an oil-field roustabout, sales, and public-relations work.

J&L Supply Announces Two Field Changes

The appointments of J. W. Johnson as assistant district sales manager of the North Texas district, and R. A. Mercer as city sales manager at Cleveland, Ohio, have been announced by W. L. Wolfe, vice president, sales of Jones & Laughlin Supply Division.

Johnson, formerly salesman at Billings, Mont., will make his headquarters at Wichita Falls, Tex. He joined J&L in 1949 as storeman at Sundown, Tex., and transferred to Snyder, Tex., in 1950. He was made field salesman in 1951 and moved to Odessa, Tex. He was shifted to Billings in 1955.

Mercer replaces F. W. Durbin, who has been assigned as special salesman for valves and fittings in Tulsa. He joined J&L in 1951 as storeman at Bushton, Kans. He was transferred to Hill City, Kans., and was promoted to salesman in 1952. He most recently served at Wichita, Kans.

Halliburton Shifts Seven In Field Operations

TOM E. MORTON

Harry P. Conroy, Halliburton Oil Well Cementing Co.'s vice president for field operations, has announced a number of changes in the company's field administration. Tom E. Morton, former manager of the California division, has transferred from Los Angeles to the Mid-Continent area on special assign-

JOE MALY

OBIE STALCUP

ment. Joe Maly has moved from Oklahoma City, where he has been manager of the Oklahoma division, to head

W. L. HUGHES

P. C. MAYFIELD

the Rocky Mountain division at Denver, Colo.

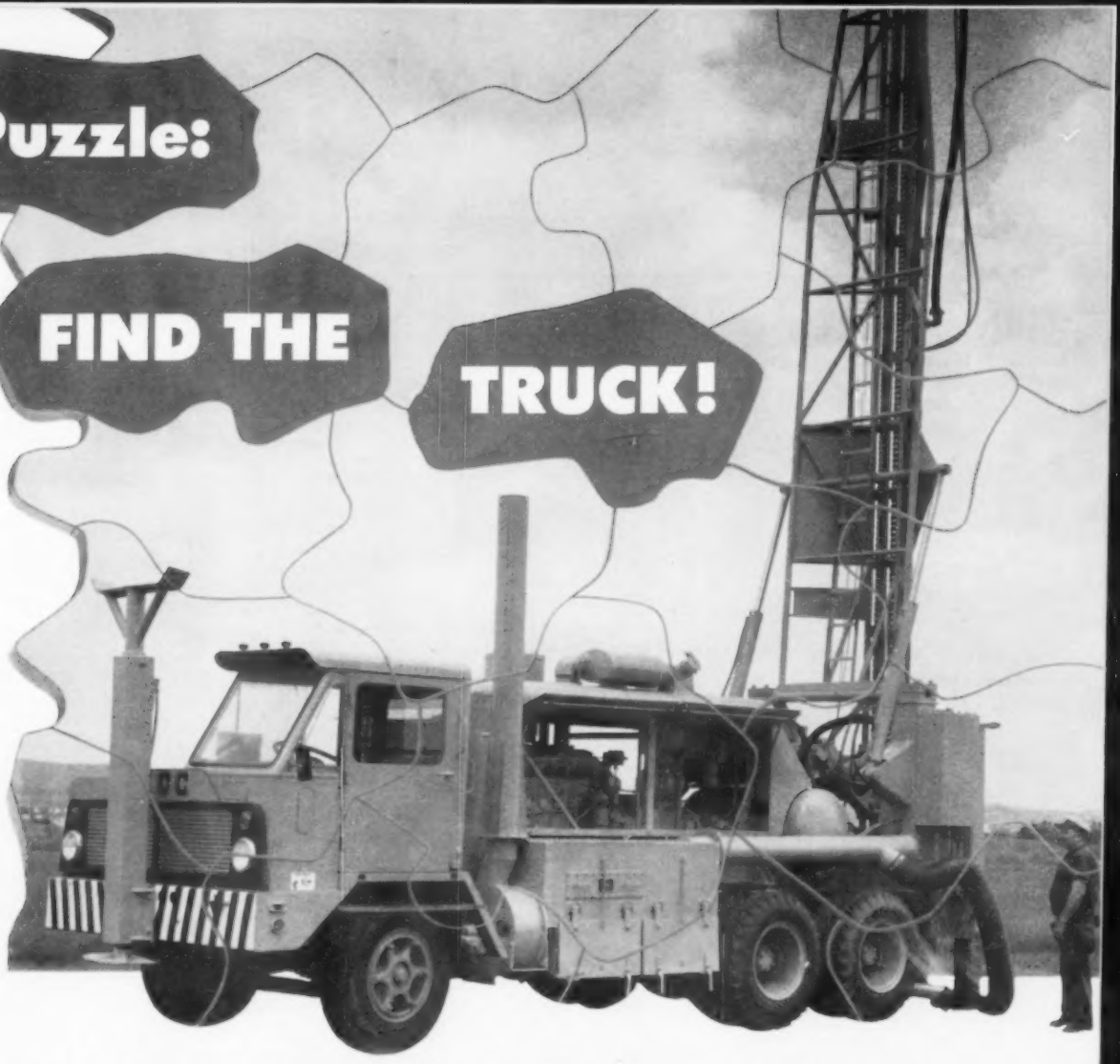
The former Rocky Mountain division manager, Obie Stalcup, has transferred to Lubbock as manager of the Lubbock division. W. L. Hughes, former manager of the Lubbock division, has moved to Midland to head the Midland division. The former Midland

LEE BOORTZ

JESSE OGILVIE

Puzzle:

FIND THE TRUCK!



Yes . . . It's hard to tell where the truck ends and the drilling rig begins . . . because here is a masterpiece of coordination, in appearance and *on the job!* This is INGERSOLL RAND'S DRILLMASTER mounted on a carrier specifically engineered to insure greatest efficiency of operation, and increase its life and value to a user. The carrier is one of many we have designed, in cooperation with manufacturers and users, for equipment which requires ready mobility under the most rigorous conditions . . . the dependable mobility that only rugged vehicles made by Crane Carrier can offer.

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division manager, P. C. Mayfield, has shifted to Oklahoma City as Oklahoma division manager.

The new manager of the California division is Lee Boortz, formerly assistant manager at Los Angeles. Boortz began with Perkins Cementing Co., later acquired by Halliburton, in 1929 as driver of a cementing truck. The new assistant manager of the California division is Jesse "Mac" Ogilvie, who has been district superintendent at Norwalk, Calif.

Atlas Pipe Forms Metal Protection Subsidiary

Atlas Pipe, Inc., Houston, has announced the formation of a new, wholly owned subsidiary firm, Atlas Metal Protection, Inc., specializing in corrosion prevention and control services for the petroleum and chemical industries.

W. H. Becker, president of Atlas Pipe, said the offices and plant of the new firm have been established adjacent to the Houston plant of Atlas Pipe.

Services offered by Atlas Metal Protection consist basically of three different coating and lining processes, using rubber, plastics, and sprayed zinc, respectively. In addition the firm is equipped to carry out acid-cleaning operations and sand blasting.

Oscar Hunter, specialist in corrosion problems and former president of Corrosion Control Co., is general manager of the new company. Officers of the subsidiary are W. H. Becker, president; Alvin Zwerneman, executive vice president; Richard Chacon, vice president; and Herbert J. Johnson, secretary-treasurer.

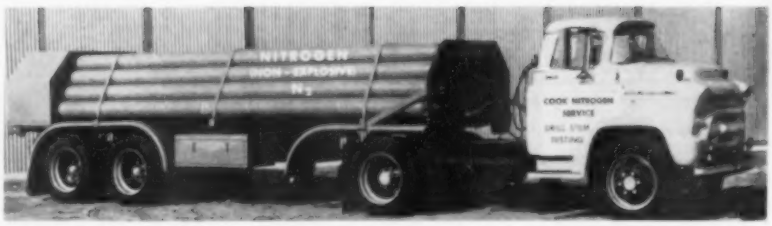
Continental-Emsco Names Haugh to Head New Office

Continental-Emsco Co. has opened a new sales office in Chicago under the direction of Harry T. Haugh. The new office is located in the Pure Oil Building. Haugh, formerly a sales representative located in Salem, Ill., joined Continental-Emsco in 1951.

Christensen Appoints Two District Managers

Ted Clanton has been appointed district manager of the newly formed Farmington, N. M., district. John Fry, field engineer in Brush, Colo., is now manager of the Brush district with a suboffice in Sidney, Neb.

In his new position, Clanton will be in charge of all sales and service in the Four Corners area.



Cook Testing Completes Nitrogen Plant

Cook Testing Co., Long Beach, Calif., has recently completed a new nitrogen plant in Odessa, Tex., where the company manufactures its own nitrogen and offers nitrogen services for drill-stem testing, production, and refining requirements.

The company maintains five complete nitrogen trucks like the one shown above. Used in conjunction with drill-stem testing, the nitrogen blanket provides more accurate information due to the operator's ability to control the test from the surface and to secure uncontaminated tests.

Otis Receives A.I.M.E.'s John Franklin Carll Award

H. C. OTIS, SR.

Herbert C. Otis, Sr., chairman of the board of Otis Engineering Corp., Dallas, last week, was made the first recipient of the John Franklin Carll award. The award was made at the October 7 fall meeting of the Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers in Dallas.

The John Franklin Carll award is made in "recognition of distinguished achievement in, or contributing to petroleum engineering." Otis was presented with a bronze plaque, bearing the likeness of Carll, whose ideas and writings first expressed principles of petroleum engineering which are now commonplace.

Otis, a 1919 graduate of the University of Michigan, was employed as superintendent, drilling and production, Bethany Oil & Gas Co. at Shreveport, La., in 1920. In 1928 he joined the gas department, Arkansas Natural Gas Co., as superintendent of drilling and production. In 1920 he capitalized on his developments and formed his own contracting firm, Southern States Co.

In 1935 Otis reincorporated Southern States under the name of Otis Pressure Control, Inc. In 1957 the company became Otis Engineering Corp. Now the company ships subsurface control equipment and supplies engineering services to high-pressure oil and gas areas all over the world.

Lufkin Foundry Opens Office at Farmington

A new district office has been opened by Lufkin Foundry & Machine Co. at Farmington, N. M., the company has announced. G. W. Nichols is the district manager for the new sales and service office which will serve the Four Corners area.

The new location will carry a complete line of Lufkin oil-field pumping units and engines. Warehouse facilities will include a large parts depot to insure immediate delivery of parts and equipment in the area.

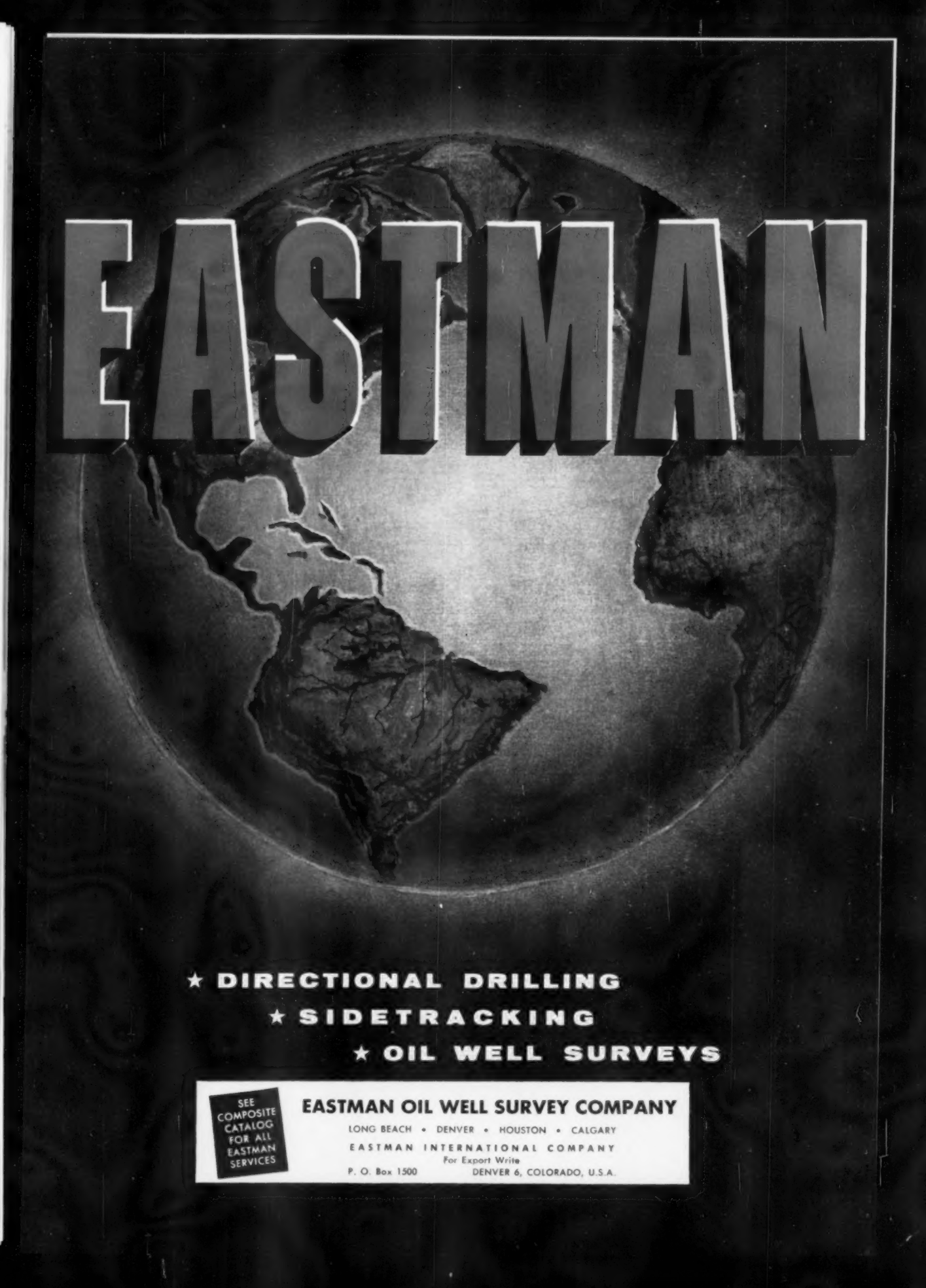
Nichols was formerly district manager of Lufkin's Kansas district with offices at Great Bend. He was first employed by Lufkin as a service engineer in the Kansas district. He was a sales representative in Colorado before returning to Kansas as district manager at the Great Bend office.

Franks, Cabot Make Simmons Sales-Service Director

C. C. SIMMONS

C. C. Simmons, Franks employe since 1934, has been named as director of sales and service for both Franks Division, Cabot Shops, Inc., and of the Cabot Shops, Inc., according to an announcement by R. A. Baker, vice president and general manager of Cabot and Franks.

Simmons has moved to Pampa and has assumed his duties in charge of sales for Franks well-servicing and drilling rigs and Cabot pumping units. He has been works manager of the Franks Division in Tulsa, in charge of shop, engineering, and service departments. He has served in almost



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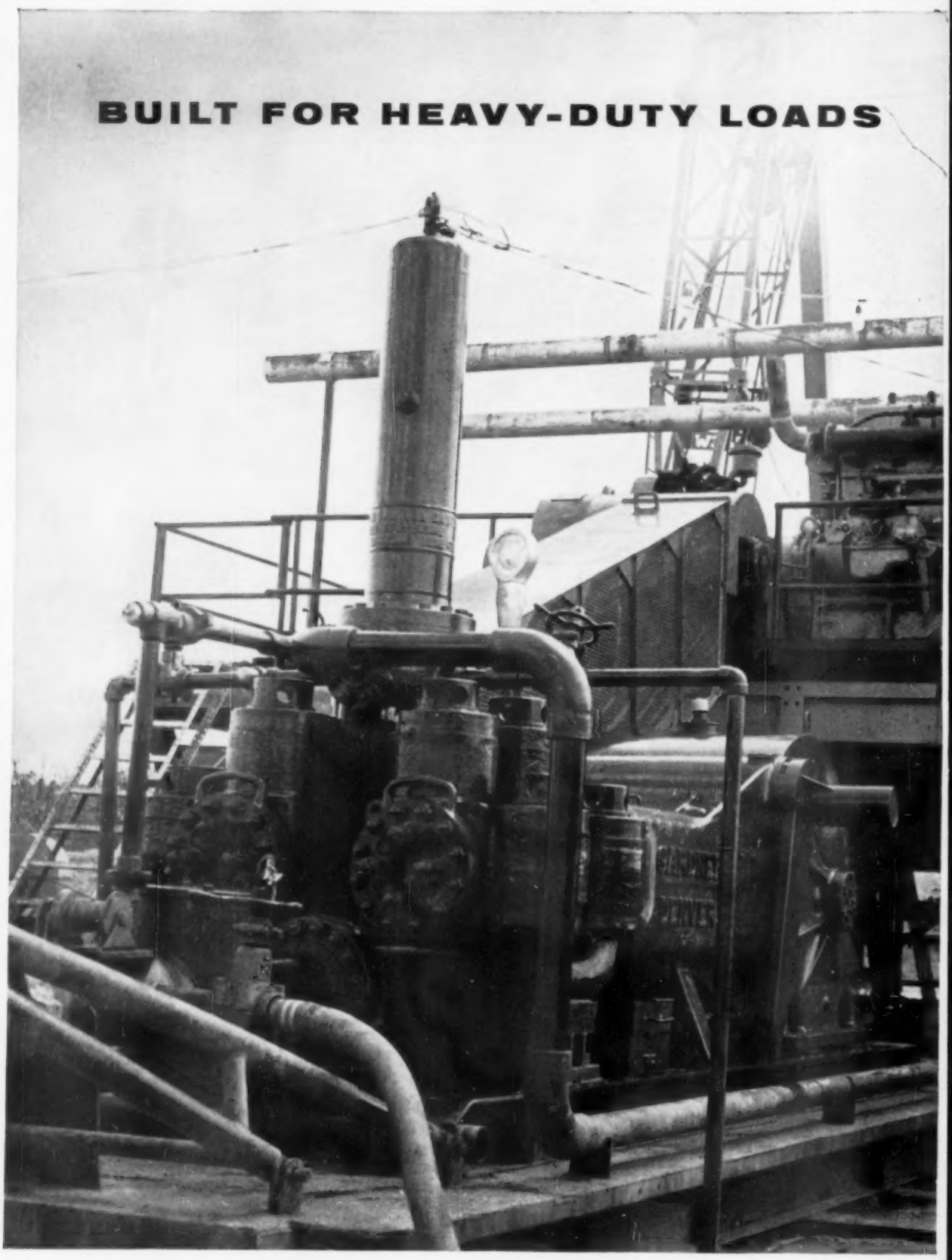
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...AT ANY DRILLING DEPTH

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1 ECCENTRIC CONSTRUCTION — Large eccentric provides low-pressure bearing areas, smooth operation, extra resistance for shock and high plunger loads.

2 DIVIDED FLUID CYLINDER END Interchangeable fluid cylinders, threaded locks and rings speed replacement of individual parts on location.

PLUS

LARGE-AREA BRONZE BEARINGS—to stand strain of high reciprocating loads.

POSITIVE PRESSURE LUBRICATION—to power end parts and bearings.

MODELS FROM 52 to 1250 hp.—capacities and pressure ratings to meet any deep drilling requirement.

SERVICE SPECIALISTS—strategically located throughout the oil country.

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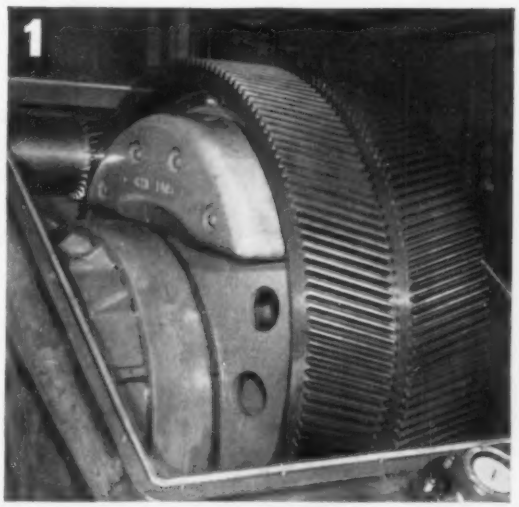

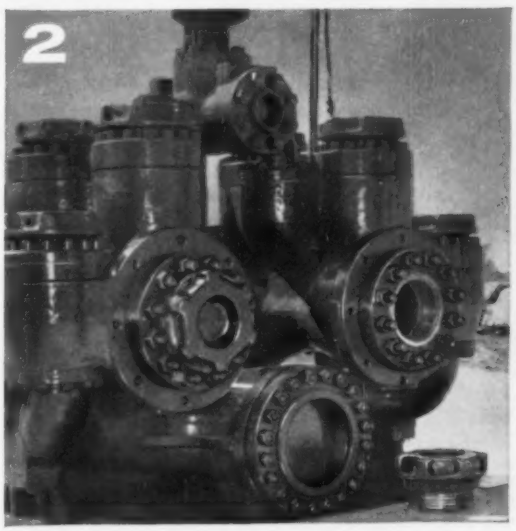

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Gardner-Denver Company, Quincy, Illinois. In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario. Gardner-Denver Export Division, 233 Broadway, New York, N. Y. Oil field offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, San Francisco, Kansas City, Winnipeg, Edmonton. Republic Supply Company, P. O. Box 2137 Terminal Annex, Los Angeles 54, Calif.

every capacity in the Franks organization, including the field, service department, shop, and in administrative positions.

Leschen Appoints Hannon District Sales Manager

W. J. Hannon has been appointed Chicago district sales manager for Leschen Wire Rope Division, H. K. Porter Co., Inc., according to an announcement by Gordon N. Dow, general sales manager.

The district includes Michigan, Wisconsin, North Dakota, eastern Iowa, and northern Illinois, and Indiana.

Oil Well Announces Changes In Mid-Continent Area

A number of personnel changes have been announced by Mark Barkhurst, Mid-Continent area manager of U. S. Steel's Oil Well Supply Division. Phillip L. Baker has been appointed as manager of the Seminole, Okla. store.

Basil L. Bristow has been promoted to field representative at Pawhuska, Okla., William A. Harding has been promoted to field representative at Medicine Lodge, Kans., and James B. Mundy, field representative, has been transferred from Healdton, Okla., to Ponca City, Okla.

Baker was employed by Oil Well in 1951 and in 1952 was appointed field representative. Bristow has served Oil Well at the Pawhuska branch since 1955. Harding joined Oil Well at Medicine Lodge in 1956. Mundy was employed in 1954 at Lindsay, Okla., and in 1956 was appointed field representative at Healdton.

Baroid Makes Key Personnel Changes

F. B. VICK

N. K. TSCHIRLEY

Baroid Division, National Lead Co. has announced the appointment of Kemp S. Lewis as administrative assistant to the manager, drilling-mud department. Forest B. Vick has been appointed chief drilling-mud engineer. Replacing Vick as assistant chief drilling-mud engineer is Norman K. Tschirley. Kenneth D. Tanner has been appointed area engineer, Louisiana Gulf Coast, replacing Tschirley.

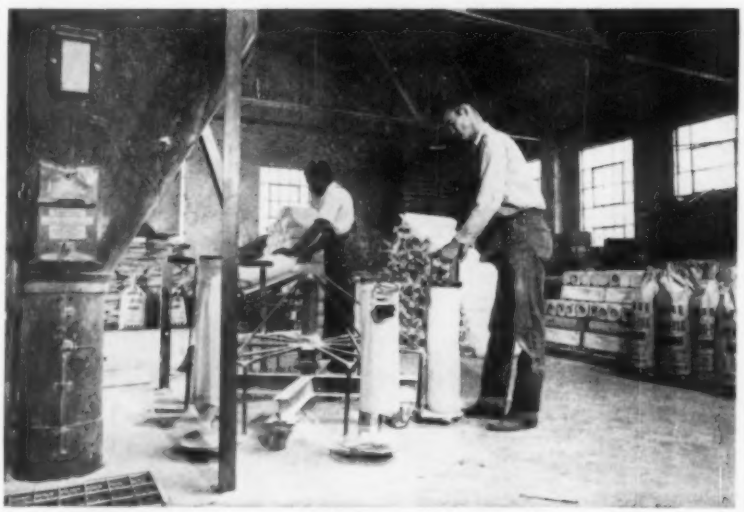
K. D. TANNER

Lewis has been with Bariod since 1939 and has served as service engineer, well-logging captain, district superintendent, and division superintendent, Bentone sals manager, manager of mineral and chemical sales, and sales-development engineer. Vick joined Baroid in 1946 and his previous positions were service engineer, assistant division field service engineer, district superintendent, and assistant chief drilling-mud engineer.

Tschirley began working in Baroid's well-logging department in 1949; in 1951, he became a drilling-mud service engineer, and in 1955, area engineer. Tanner went to work for Baroid as service engineer in 1952.

Cummins Opens Maintenance Shop at Farmington, N. M.

Cummins Sales & Service, Inc., has increased to 16 the number of factory-type maintenance shops it operates in the six-state Mid-Continent area with the recent opening of complete sales and service facilities in Farmington.



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  - Selenium Rectifiers—improved design, air-cooled
  - Dow magnesium anodes, including the new Galvomag
  - Special anodes to your own specifications
  - Galvo-Pak—Vibration-packaged—silver-soldered lead wires, patented quick-wetting backfill
  - Large stocks for immediate shipment
- ✓ **Expert consulting and installation services.**
  - Engineering personnel with long experience—trained crews
  - Equipment to handle the largest turnkey job—rectifier or anode
- ✓ **Competitive prices.**

Call or write today for estimates or quotations. Let our stockholder-employees demonstrate the economical and satisfactory service they can give you.

CSI

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P. O. Box 7343, Dept. J19 **Telephone: Circle 5-1351**

Announcing another addition to J&L Supply stores in the United States and Canada — this one at Liberal in southwest Kansas to back up the work of men bent on exploration, and development of the Anadarko Basin and the Hugoton Embayment.

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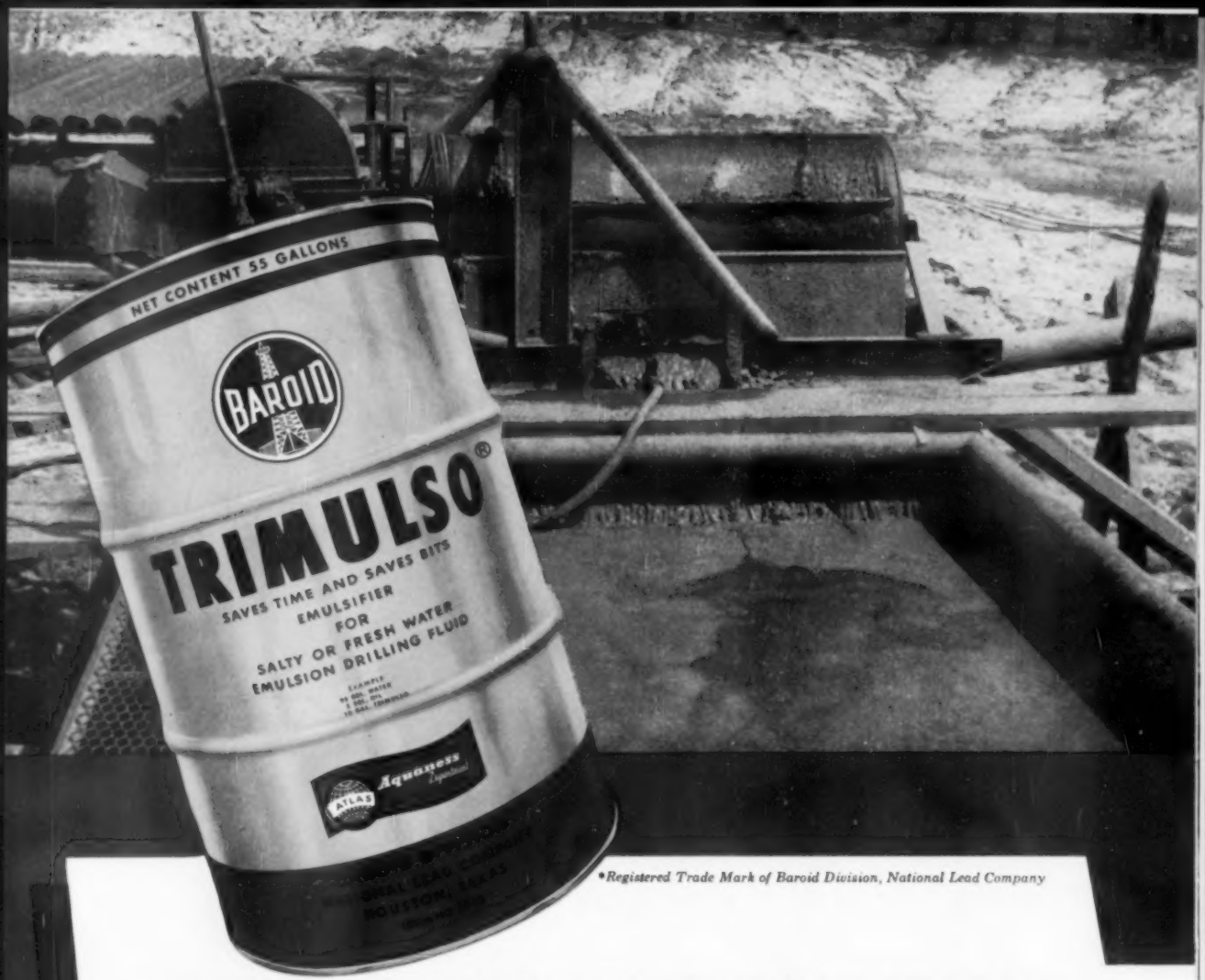
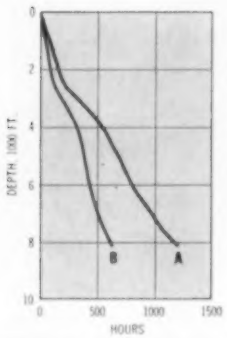


*Registered Trade Mark of Baroid Division, National Lead Company

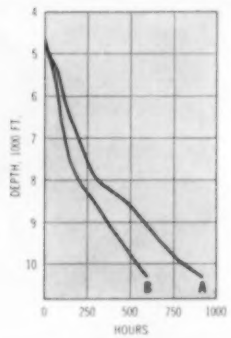
RESULTS LIKE THESE IN OVER 750 WELLS PROVE PERFORMANCE

(Legend: A—drilled with mud B—drilled with O/W)



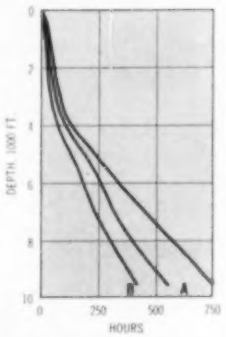
• SAVES 382 HOURS OF DRILLING

On an offset well in Eddy County, New Mexico, operator saved a week of day rate. Penetration rate was doubled with oil-in-water emulsion. Contractor saved ⅔ of bit cost, two weeks' wear on rig.



• COMPLETED TWO WEEKS SOONER

In Gaines County, Texas, well drilled with oil-in-water emulsion was completed in 606 hours . . . compared with 904 for an offset well of comparable depth. Cost per foot was $3.50 lower.



• 30% LESS DRILLING TIME

Comparative results in Hockley County, Texas: 9600-foot wells. Oil-in-water emulsion cut drilling time 245 hours, reduced number of bits by 25% . . . gauge hole required less cement.

Get faster, better completions by drilling with low-solids fluid

New wells completed up to 44% faster . . . when drilled with low-solids, oil-in-water emulsion fluid. TRIMULSO* emulsified drilling fluids are cutting weeks off drilling time . . . the proved way to get new wells drilled and on production with minimum hole trouble and in less time than ever before. Use TRIMULSO and get lower drilling costs per foot.

Better completions: This oil-emulsion drilling fluid has less tendency to block producing sands.

Fast penetration: Less time from spud-in to completion.

True gauge hole: Less cement is needed.

Larger cuttings: For better geological analysis.

Saves time and reduces drilling costs: by increasing bit life . . . reducing wear on rigs . . . allowing higher weight on bits . . . preventing corrosion of drill stem . . . reducing lost circulation. This light weight mud is easy to control. Cuttings settle out quickly in pits.

Use TRIMULSO for your next drilling job. Get full data from your Baroid service engineer today.

LOOK FOR THE AQUANESS SEAL

. . . it identifies the *original* low-solids high-speed drilling fluid emulsifier, made by Aquaness to highest quality standards.

ATLAS

Aquaness Department

ATLAS POWDER COMPANY

2005 Quitman Street, Houston 26, Texas

The new shop will specialize in servicing the Cummins diesel and turbodiesel engines powering drilling rigs and well service trailers in the San Juan basin and Four Corners area.

District Manager L. C. Hardin, with Cummins 12 years, heads the Farmington office. It is the first Cummins branch to be opened west of Odessa, Tex., and the first shop in New Mexico, although the company previously had a sales representative at Farmington and currently has one at Hobbs.

Fifteen other Cummins branches are located in Texas, Oklahoma, Louisiana, Mississippi, and Kansas.

Baash-Ross Makes Mays Sales Manager in Dallas-Fort Worth

H. C. MAYS

H. C. Mays, who has been with the company for the last 9 years, has been appointed Dallas - Fort Worth sales manager for Baash-Ross Tool Co., division of Joy Manufacturing Co., it has been announced by H. L. Messinger, general sales manager.

Mays started with Baash-Ross in 1948 as field salesman with headquarters in Lubbock, Tex. In 1950 he was shifted to Hobbs, N. M., to act in the same capacity. He was named city salesman in Odessa, Tex., in 1954, and a year later was promoted to area sales manager.

R. L. Anderson Represents Caterpillar Pipeline Group

R. L. ANDERSON

Robert L. Anderson has been appointed representative of the pipeline market section, sales - development division of Caterpillar Tractor Co.

In his new position, Anderson will be responsible for a program of market development for Caterpillar pipelaying crawler tractor models.

Anderson joined Caterpillar in 1953 as a college-graduate trainee. He subsequently served as a sales-training instructor, engine-division correspondent, and, for the past year, has been a sales - development special representative.

Sawyer Is Vice President Of Jacobs Engineering Co.

Dr. Frederick G. Sawyer has been appointed vice president of Jacobs Engineering Co., Pasadena, Calif. Dr. Sawyer was formerly with Ralph M. Parsons Co., Los Angeles, in chemical business development and as manager of public relations and advertising.

American Marine Delivers Ship to Tidewater Ventures

Leaving American Marine Corp. shipyards for service in gulf waters is the offshore-oil-supply vessel, Ocean Tide. Owner of the new vessel is Tidewater Ventures, Inc., of New Orleans, La. The Ocean Tide is the seventh craft built by American Marine for offshore-supply service.

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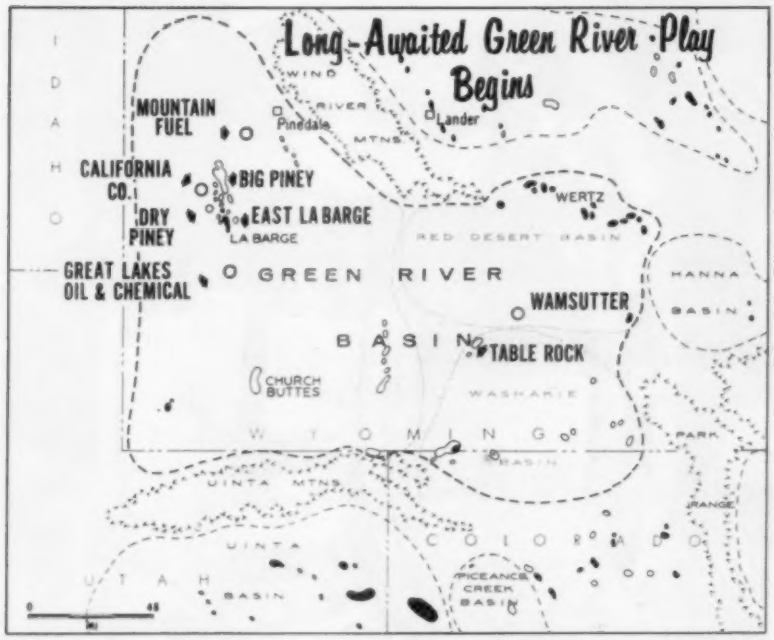


HERE IS ONE of Wyoming's almost neglected basins . . . the Green River. New drilling in old areas and important wildcats in rank locations are bringing this region back into the Rocky Mountain exploratory fold.

Green River Push Is On

By John C. McCaslin
District Editor

THE OFT-PREDICTED big push into the Green River basin of southwestern Wyoming apparently has begun. For nearly 4 years the oil sages have prophesied an accelerated drilling program in this least-tested of Wyoming basins. Sporadic surges of development have appeared and then long periods of quiet would descend. But now it looks as though drilling in this big basin is reaching a high and steady level. The Pacific Northwest Pipeline through the basin plus new emphasis on gas exploration in the Rockies is putting the bee on fields such as East LaBarge, Big Piney, Table Rock, and Dry Piney.

An old basin . . . Oil seeps were known more than a century ago in the Green River country, yet it is one of the smallest producing areas in the Rockies.

The basin extends from southwestern Wyoming into the northeast corner of Utah and the northwest part of Colorado. Its 21,000-sq. mile area is bounded on the north by the Wind River Mountains, on the west by the Wyoming Range, on the south by the Uinta Mountains, and on the east by the Rawlins uplift. A major structure, the Rock Springs uplift, splits the basin's south-central portion. The extreme eastern portion of the Green River basin is known as the Red Desert basin, while the southeast corner is tabbed the Washakie basin.

Sediments in the basin range in age from Cambrian through Eocene. The basin contains strata up to 30,000 ft. thick on its western side thinning out to the east or shelf side. Gas production is found in the Cretaceous (Lance, Frontier, Dakota, Lakota), the Triassic (Morrison), and the Jurassic (Nugget). Oil and gas are found in the Eocene, Paleocene, uppermost Cretaceous (Hilliard), Cretaceous (Mesaverde), and Jurassic (Nugget). Well-known fields in the basin include Baxter Basin, Church Buttes, Hiawatha, Los Soldier, Pinedale, Wertz, the Big Piney fields, and the LaBarge fields.

Goes on stream . . . Wyoming's most promising basin for big gas reserves appears headed for its rightful place on Rocky Mountain exploratory agendas.

. . . At Dry Piney. The most recent discovery of note in the Green River area is Belfer Natural Gas Co.'s 1 Dry Piney Unit in Sublette County.

The well was completed late in August, shut in, and no completion gage yet released. A flow of 10,000 M.c.f. of gas per day was reported from the first Frontier sand at 6,254-7,050 ft. The unit operator, Mountain Fuel Supply Co., has spudded the No. 2 Unit and staked location for the No. 3 Unit.

. . . At Big Piney. This Mesaverde gas field is now an oil producer. Gulf Oil Corp. began the oil play at its 1 Tresner-State. This well flowed 104 bbl. of oil in 12 hours from Mesaverde sands, but was completed as a gas well in the Almy for 4,063 M.c.f. per day.

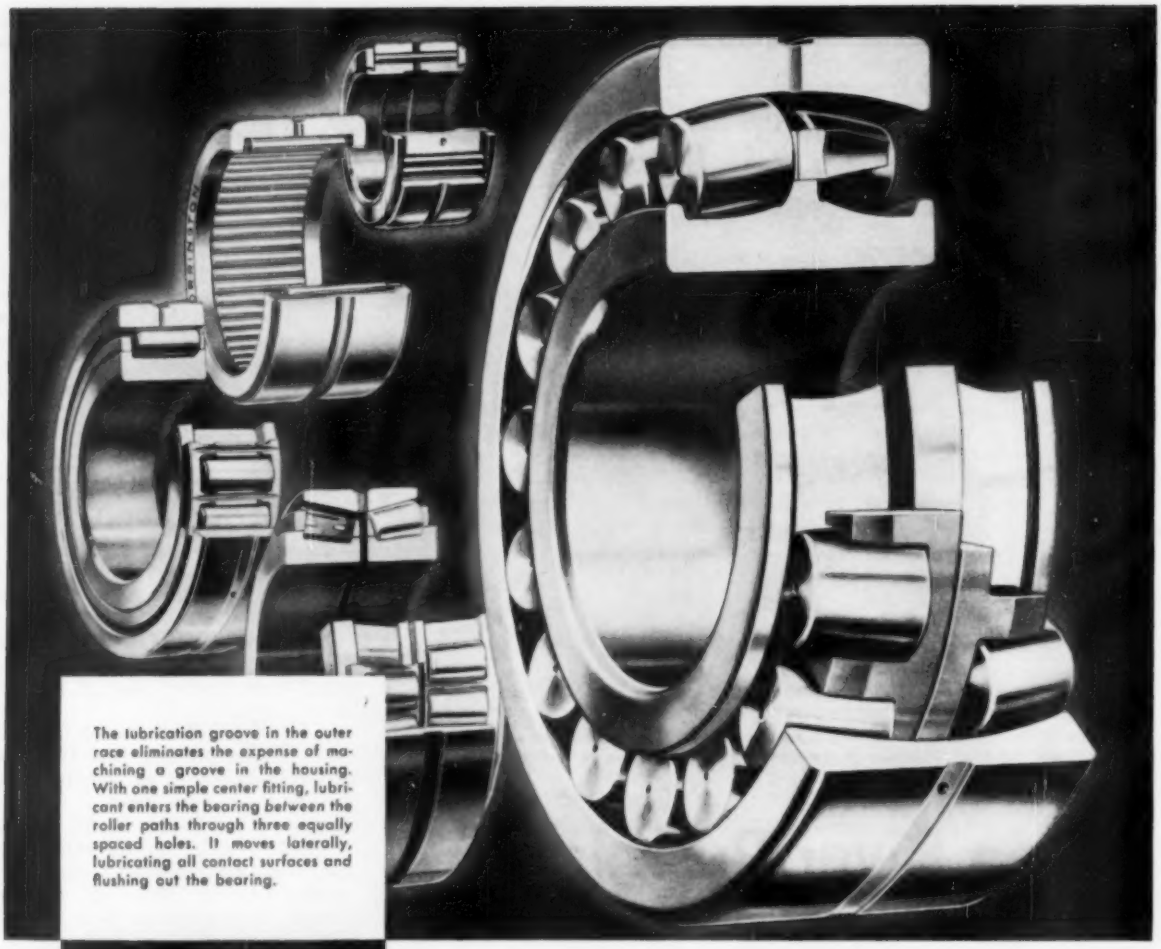
Belco Petroleum Co. B-34 became an oil producer in this gas field last month with a swab gage of 140 bbl. of oil per day.

. . . At Table Rock. Across the basin in Sweetwater County, The Texas Co. pumped 134 bbl. of 40°-gravity oil per day at its 2 Table Rock Unit. Production is from Almond (Mesaverde) at 6,532-6,650 ft. The operator shut in the well after reporting a daily flow rate of 74 bbl. This field was previously a gas producer from Wasatch and Almond.

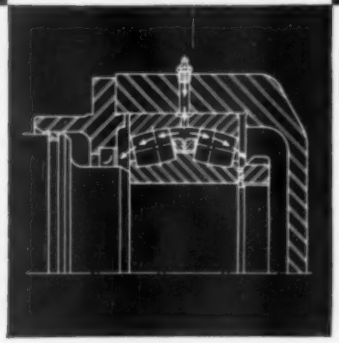
With high hopes . . . It is far too early to determine how far the new Green River basin play will go, but it does appear that the long-awaited drilling spree may be kicking off. Several important wildcats for the future of Green River basin success have been staked in scattered places around the basin.

Mountain Fuel Supply Co. will drill to 7,500 ft. at 1 Antelope Draw Unit, 18 miles northeast of Big Piney and 15 miles northwest of Pinedale field in Sublette County. Ohio Oil Co. has located a 10,500-ft. Mesaverde test in Sweetwater County's Wamsutter area. The California Co. will drill 1 Deadline Ridge Unit in Sublette County, going to 8,800 ft. or the Bear River. This is the first test on the former Mountain Fuel Supply Co. block, and The California Co. has proposed reunitization. Great Lakes Oil & Chemical Co. will take 41-21-C Unit in Lincoln County to 5,500 ft.

The new drilling interest is a part of the state-wide increase in activity in Wyoming that has put this old Rocky Mountain producer back in the game this year in a big way.



The lubrication groove in the outer race eliminates the expense of machining a groove in the housing. With one simple center fitting, lubricant enters the bearing *between* the roller paths through three equally spaced holes. It moves laterally, lubricating all contact surfaces and flushing out the bearing.



A time-proved lubricating method now available on Torrington Spherical Roller Bearings

The circumferential groove in the outer race has met the test of experience in many Torrington Bearings, including Heavy Duty Needle Bearings, Aircraft Type Needle Bearings, Tapered and Radial Roller Bearings. Now the circumferential lubrication groove is available in Torrington Spherical Roller Bearings.

This design feature makes it possible to introduce lubricant *between* the roller paths without the expense of machining a groove in the housing. This groove is proportioned to provide generous lubricant flow capacity. Lubricant moves through the roller paths, flushing used lubricant and contaminants away from bearing contact surfaces.

Torrington Spherical Roller Bearings in many sizes may be ordered with this groove as desired at no additional cost. For further information, see your Torrington representative or write: **The Torrington Company, South Bend 21, Ind.—and Torrington, Conn.**

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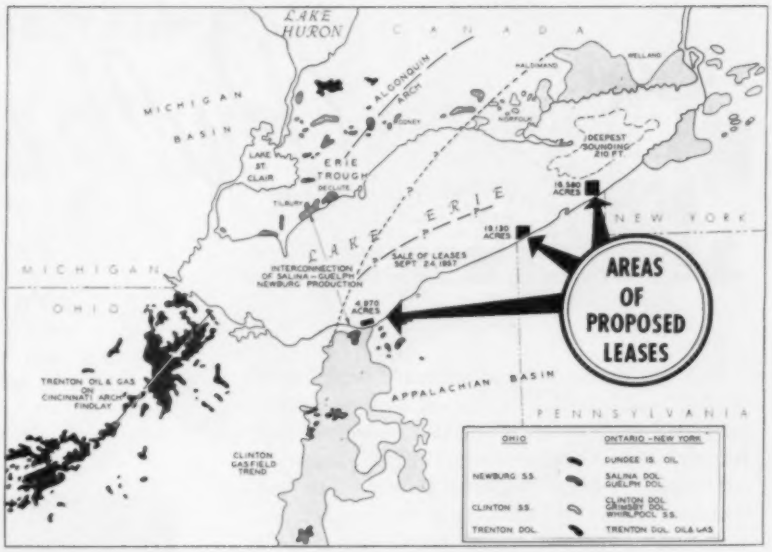

Here are the oil and gas field trends projected from the American side of Lake Erie, through the lake to Ontario. Also shown is the area in the lake which is considered too deep for drilling with present equipment (about 100 ft.). Fig. 1.

• Border states of the Great Lakes area have started or plan to start legislation necessary to lease offshore lands. Pennsylvania and Ohio take the lead and other states make plans as . . .

Great Lakes Leases offer new drilling area

By Bryson C. Donnan

THE STATES of Michigan, Ohio, Pennsylvania, and New York have been missing a bet. Many thousands of dollars in state oil and gas royalties and lease income from state-owned lands under the waters of the Great Lakes should be pouring into state treasuries. But they are not, simply because those states have done nothing about it.

But it won't be long in coming. Ohio and Pennsylvania have enacted the necessary legislation. Ohio has a state lease pending but no date has been set for it. Meanwhile, Pennsylvania has conducted its first offshore sale of leases; on September 24, the state offered 35,710 acres off its Erie shore. These went for $90,906.50.

Within a year or two, it is probable that all the states bordering Lake Erie will have enacted bills authorizing the sale of such leases. And the imaginative enterprising oil operator can be counted on to make the most of the opportunity.

Meanwhile, across the lake, Ontario is already reaping the benefits. With a fair and generous offshore lease law, the province has already begun to tap the oil and gas sands extending out under the water from onshore fields. In Lake St. Clair and western Lake Erie, scores of productive gas wells have been completed. Now, Ontario operators are poised to begin a campaign along the entire northern shore, now completely leased.

Author is consulting geologist, Clarkson, Ont., Canada.

General Geology

This article covers the area on the Ontario side of Lake Erie, where sediments of Cambrian, Ordovician, Silurian, and Devonian age are found.

Structurally, one of the main controlling factors in the geology of the general region is the Cincinnati (Findlay) arch, a broad anticlinal feature stretching from the Ohio side of Lake Erie to join the Algonquin arch of Ontario. There is a local dip in the arch in Ontario, termed the Chatham sag or the Erie trough.

The Appalachian basin is situated on the southeast side of the arch, and the Michigan basin on the northwest.

Table 1 gives typical formations for the area.

Potential pay horizons . . . Exploratory activity in this oil and gas province is generally directed toward the following formations:

Devonian: Dundee, Columbus.

Silurian: Salina A-2, Salina A-1, Guelph (layer and pinnacle reefs), Clinton (i.e. Thorold sandstone), Medina (Thorold, Grimsby and Whirlpool).

Ordovician: Trenton.

Cambrian: Eau Claire, Mount Simon.

The Detroit River and Bass Island formations contain porosity, and this is generally found to be water bearing. The Sylvania sandstone (Oriskany) at the base of the Devonian is present in some areas and should be watched carefully for productive possibilities.

Geophysical methods . . . Seismic surveys have been unsatisfactory in locating structure because of the relatively thin veneer of sediments and complex drift conditions. However, equipment has improved since seismic experiments were conducted in this region and perhaps operators should take a second look at this method especially under Lake Erie where depth to basement is an estimated 5,000 ft.

Magnetic surveys have been conducted on land, but their usefulness has been limited by their interpretation. And they reflect the magnetic influence of the basement rocks, in the main, rather than the structural variations within the sedimentary rocks. Gravity-meter surveys have been commonly used as the basis for choosing well locations. These are particularly useful in locating Guelph reef developments over salt-bearing areas, owing to the density differential where underlying structures cause a thinning of the evaporite section. The key to gravity interpretation outside of the salt-bearing areas apparently is yet to be found.

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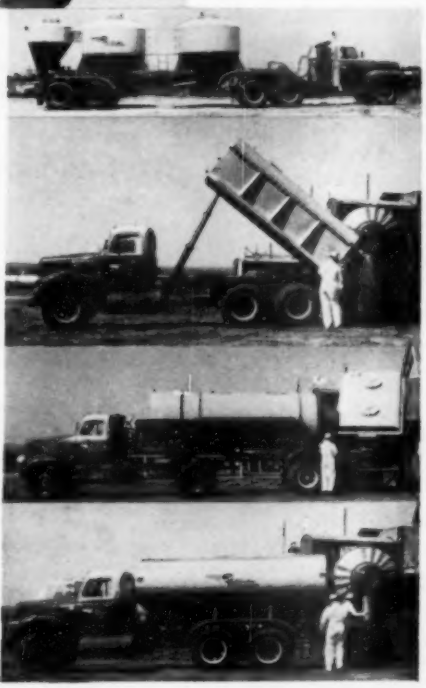
Halliburton bulk cementing offers many advanced benefits, including:

- Eliminates waste of cement during mixing—results in cement savings of approximately ten per cent, compared to sacked cement.
- Elimination of caking, lumping and spoiling of cement at well.
- Neat cement unused is returned to bulk plant for credit instead of being left on ground and lost.
- Industrial hazards are reduced.
- Cement is fully protected against weather while en route to well.



At Halliburton, bulk cementing is completely integrated, from bulk cement plant to mixer. To improve bulk cementing still further, Halliburton has developed a number of special cements and chemical additives to formulate cements to meet individual well requirements.

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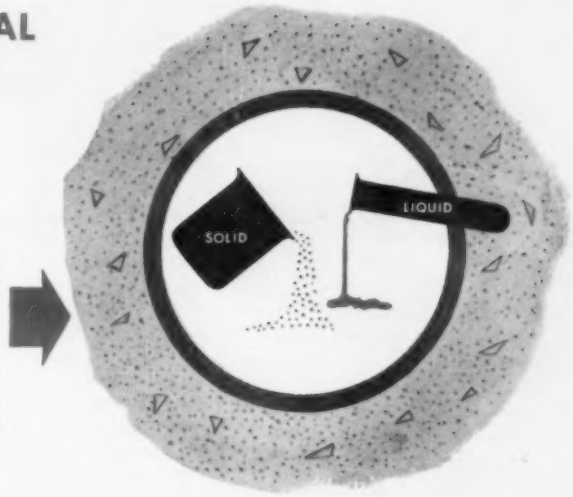

DIACEL CEMENT

Diacel cement is a low density composition. Diacel D, a light weight additive blend with portland cement, is used to increase the volume of mixing water, resulting in a lighter weight slurry and a greater yield. Where low fluid loss properties are desired, Diacel LWL can be used to give filtration rates comparable to drilling muds. This low water loss additive can be utilized with virtually all types of cementing composition; also functions as a retarder for deep well cementing.

HI-DENSE

Hi-Dense is a high specific gravity weight material designed to increase the density of cement slurry for controlling high pressure gas and oil zones. Hi-Dense is ground to a fineness that requires a minimum amount of mixing water. Because of the specific gravity of Hi-Dense, it is possible to weight cement slurries to 20 lbs./gal., yet still maintain adequate pumpability and strength stability at high temperatures.

POZMIX 140

Designed for oil well cementing where formation temperatures range from 140° to 400°F. or higher, Pozmix 140 is a pozzolanic composition made up of Pozmix "A" or "S", hydrated lime and set control additives to give it early initial strength. It contains no portland type cement. At temperatures greater than 140°F., Pozmix 140 equals or exceeds strength specifications for oil well cements and is greater than many other types of cementing compositions when used under the same conditions.

SALT BRINE CEMENT

The dry blending of salt in cementing composition eliminates foaming and delay in dissolving salt in water before mixing with cement. A saturated Salt Brine Cement improves the bond to a salt formation and does not dissolve the salt as would occur with the circulation of fresh water slurries. In deep wells, Salt Brine Cement does not require retardation, as saturated salt brine will sufficiently retard cement to permit placement.

MUD-KIL

Mud-Kil is a dry, granular material that may be mixed in the dry cement or dispersed in the mixing water. It effectively neutralizes the cement-retarding properties of quebracho and other tannins, starch, sodium carboxymethyl cellulose and lignite. Pumping time and compressive strengths of cement are unaffected.

HR-4 CEMENT RETARDER

Halliburton HR-4 is a chemical retarder used in portland or Pozmix Cement to retard the set to allow placement at high temperatures. A small amount of HR-4 is added to the dry cement at the bulk plant or in the mixing water to provide a tailored composition for cementing casing in the deepest of wells.

HR-7 CEMENT DISPERSANT AND RETARDER

Halliburton HR-7 is a chemical dispersant and retarder for use with high gel cement compositions. This additive is effective in obtaining smoother and more fluid gel cement slurries. Most applicable in wells where moderate temperatures prevail.

CALCIUM CHLORIDE

An accelerator for Pozmix Cement or portland cement to increase the early strength and reduce the waiting on cement time. Most effective at low temperatures (40-100°F.) for surface pipe or shallow wells.

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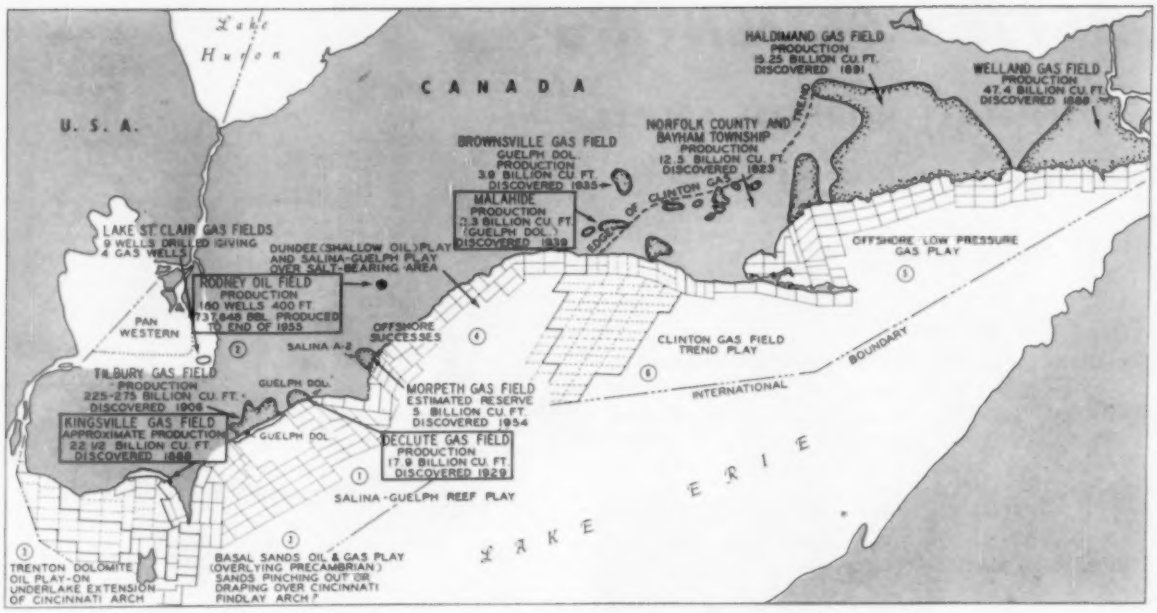

THIS IS THE OFFSHORE ACREAGE picture in Lake Erie, indicating generally the oil and gas plays. Fig. 2.

A new method of airborne gravity surveying should find much use in the area, since it has responded favorably over some known productive areas.

The underwater gravity meter is lowered to the lake bottom from a work boat; the instrument is then remotely leveled and readings are taken remotely. Stations are located by triangulation from the work boat by shooting two or more known points onshore with a marine sextant

Drilled holes generally have not been commonly logged in this oil and gas province because of cost considerations; however, some companies are making use of the radioactivity log. Electrologs are not run with the open hole.

General Geologic Thinking

The Dundee and Columbus formations (Devonian) (Fig. 2, Area 4) yield oil at shallow depths of 270-475 ft. Rodney oil field produces approximately 350,000 bbl. of oil per year from some 180 wells drilled to approximately 400 ft. (Columbus formation). In appropriate areas, this type of shallow structure might lend itself to discovery by means of shallow-structure test holes. This would help in locating the Dundee limestone bed rock, immediately underlying the drift, minus the usual veneer of Hamilton shale; or it might locate areas of thinning of the overlying shale, or locate positive structure on the Dundee.

There is a tendency for Dundee and Columbus production to fall within the area covered by the Erie trough.

The Salina A-2 and A-1 units are productive in certain areas. The A-2 produces mostly gas, the A-1 oil. Morpeth and Tilbury gas fields produce from the A-2 unit. Production in these units is sometimes associated with underlying Guelph structure.

Guelph reefing (Fig. 2, Areas 1, 3, 4) lends itself to discovery by means of gravity work. Numerous productive pinnacle reefs or bioherms are found on the north side of the Algonquin arch. To the south, as in the cases of the Kingsville, Tilbury, and DeClute gas fields, are found the larger biostromic reefs; these are of lower relief and also are present in Ohio. Guelph gas is normally sour, and brings 35 cents per 1,000 cu. ft. to the producer.

Some gas production corresponding to the Salina-Guelph productive horizons of the Tilbury region of Ontario was found on the northern tip of the Ohio Clinton gas-field trend in the vicinity of Cleveland (termed Newburg production). Because of this some geologists believe in the possibility of an interconnection. However, this is open to interpretation.

The Clinton formation shows definite indications of a trend across Lake Erie (Fig. 2, Area 6). Some geologists feel that it does so in the way shown, stretching from Ohio to join the Clinton production in Ontario.

The base middle Ordovician contours show a tendency to swing east on crossing the south shore of Lake Erie. Approximately 700 ft. higher in the stratigraphic section, the top Trenton contours show more of a tendency to cross the lake. Finally, some 1,000 ft. higher stratigraphically, the contours on the thickness of the Upper Ordovician show a trend which coincides with the postulated projection of the Clinton gas field trend. The productive Medina formations (Clinton, etc.) were laid down on top of the Upper Ordovician strata. This trend parallels, roughly, the Algonquin arch in Ontario.

Some geologists believe the trend swings more to the east after crossing in the vicinity of Cleveland into Lake Erie. The correct theory will only be proved by further exploratory drilling in the lake; important gas reserves will probably result either way.

The productive Clinton sandstone of Ohio is of Medina age. In Ontario the term Clinton includes both the Clinton dolomite and the underlying (and productive) Thorold sandstone. The Thorold is of Medina age as well, so that the productive zones on both sides of Lake Erie probably are directly related, stratigraphically.

In the extreme northeast of the Clinton trend, production is found not only in the Clinton formation but also in the Grimsby and Whirlpool sandstones of the Medina formation. (Fig. 2, Area 5). The type of trap is considered monoclinal, the formations dipping to the south at about 28 ft. to the mile. Cementation and lensing probably controlled production to some extent because of variations in flows and pressures found in wells.

The gas is sweet, bringing 35-45 cents per 1,000 cu. ft. to the producer. Wells which originally showed pressures in 1890 of 430 psi. now produce at 78-105 psi. (2,475 wells produced an

average 1,075,000 cu. ft. per well in 1952). These gas fields (Haldimand Welland) produced a total of 57,460 M.M.c.f. to the end of 1952. Present production is rather small, ranging 50-200 M.c.f.d. although flows of 2,000,000 cu. ft. per day at pressures of 385 psi. have been found in some wells near shore in Sherbrooke Township.

The Trenton formation is mainly limestone in Ontario, whereas in the sprawling oil and gas fields of Ohio, where it is productive on the Cincinnati arch, it tends to become dolomitized. As often happens, rules of thumb develop in the geologic profession so that the production has become associated with dolomitized Trenton. However, it is best to keep an open mind on such theories. The dividing line between dolomitic-Trenton and limestone-Trenton apparently runs between Ontario and Ohio, somewhere in the west end of Lake Erie. Initial production rates of 4,000 and 12,000 bbl. per day have been recorded in Ohio, the former near Lake Erie.

The basal beds of Ordovician and Cambrian age are thought to have oil and gas possibilities where they drape over or offlap the Cincinnati arch at the west of Lake Erie. Some interesting oil and gas shows have been found, and on occasion, sand has flowed to surface in wells which have penetrated this zone in Essex County, Ontario.

Operators should frequently reappraise the possibilities of exploring major structural features such as the Cincinnati arch, with a view to finding production in deeper horizons such as the basal beds.

Fig. 1 shows the oil and gas field trends projected into Canada and illustrates how a considerable part of Lake Erie is suitable prospecting ground for oil and gas.

Current Exploratory Activity.

General . . . More than 1,850,000 acres of offshore oil and gas lands have been applied for on the Canadian side of Lakes Erie and St. Clair and some 10,000 acres in Lake Huron. Generous Ontario legislation provides for large blocks of holdings which are issued on an initial 3-year exploratory basis, prior to actual leasing. An estimated 40 wells will be drilled on this offshore acreage in 1957 in the Lake Erie region. Similar activity would undoubtedly follow on the American side should favorable offshore legislation be enacted. The State of Ohio is contemplating leasing 4,970 acres of offshore acreage near Cleveland (Fig. 1).

Oil and gas production in Ontario is very economic owing to the proximity of markets, low costs, shallow depths, and good prices for products, among other advantages. However, the type of production obtained cannot be compared with that found, say, in western Canada, everything being in miniature by comparison. Production has been known to be prolific in some instances (e.g. pinnacle reefs, Petrolia oil field, Tilbury gas field). In other instances, it has been small but long lasting.

Interested companies . . . Consolidated West Petroleum Ltd. has drilled 41 gas successes on the under-lake extension of the Tilbury gas field, and has drilled in excess of 50 wells in Lake Erie. Though a subsidiary, Underwater Gas Developers, Ltd., Consolidated is making its methods and equipment available to others on a contract basis.

Sparked by this company's success and by the fact that lake drilling is now an economic reality, numerous other companies, individuals, and syndicates have applied for acreage. Phillips Petroleum Co. is reportedly spending $200,000 on 21 Exploratory Licenses of Occupation in the west end of Lake Erie. Other companies operating offshore acreage are: Cree Oil of Canada Ltd., Imperial Oil Ltd., Dome Exploration (Western) Ltd., New British Dominion, French Petroleum Co. of Canada, Pan Western, Lake St. Clair Gasfields, Spooner Oils, Midcon Oil & Gas Ltd., Yellowknife Bear, Wespac, Texas-Calgary (Alator acreage), Canadian Prospect, Bluewater Oil & Gas, Canadian Export, Long Point Gas & Oil Ltd., Plateau Petroleums, Petroleum Reserves, Harvest Petroleums Ltd., Huron Petroleums Ltd., and Hirshborn (Place Oil & Gas). Other companies reportedly are being formed to develop holdings.

Oil and gas plays . . . Fig. 1 shows the oil and gas fields trends projected from the American side of the lake, through Lake Erie to Ontario. It also shows the area in the lake which is considered too deep for drilling with present equipment (about 100 ft.).

Fig. 2 shows the offshore acreage picture and indicates generally the oil and gas plays.

. . . Area 1 in Fig. 2 covers the general region where the pioneer company, Consolidated West Petroleum, started all the lake drilling activity by attempting to drill an offshore gas well from a wooden framework 1¼ miles from shore some 14 years ago. This was swept away by drifting ice in the winter time. It took a full season to drill a well then, as compared with 3 to 4 weeks now. Drilling is currently conducted on the under-lake extension of the 50-year-old Tilbury gas field at the rate of 16 wells per season with the use of three to four offshore drilling towers. The company now has seven towers, with three of them out on contract work.

Table 1—Typical Formations (Lake Erie Area)

Age	Formation	Thickness, ft.
Pleistocene and recent	Surface	0- 150
Devonian	Port Lambton Kettle Point (Huron)	0- 290
	Hamilton	110- 340
	Dundee Columbus Detroit River Group (Bois Blanc) Sylvania (Oriskany)	375- 725
Silurian	Bass Island	35- 400
	Salina	300- 440
	Salt Beds C-Unit A-2 Unit A-1 Unit	
	Guelph-Lockport	75- 500
	Clinton Group	
	Rochester	10- 70
	Irondequois-Reynales	2- 35
	Medina Cataract Group	38- 180
	Thorold Grimsby Cabot Head Manitoulin Whirlpool	
Ordovician	Queenston	130- 500
	Meaford-Dundas	200- 670
	Blue Mountain-Collingwood (Billings)	104- 270
	Trenton Coburg Sherman Fall Kirkfield	765- 990
	Black River Coboconk Gull River Shadow Lake	
Upper Cambrian	Eau Claire	0- 50
	Mount Simon	0- 140
	Jacobsvile	0- 45
Precambrian		Depth Approx. 4,200 ft.

In this area, operators have been drilling immediately offshore from known gas fields (as at Kingsville, Tilbury, and DeClute), or farther out in the lake in search of similar biostromal type of production. These reservoirs characteristically cover fairly large areas. The production from Tilbury gas field on land is some 275 billion cubic feet. In addition to Consolidated's success, this year Midcon Oil & Gas, Submarine Oil & Gas, and Bluewater Oil & Gas have drilled offshore gas successes opposite gas fields on land.

. . . Area 2 in Fig. 2 covers the Canadian side of Lake St. Clair. Here, nine wells were drilled by Lake St. Clair Gasfields, Ltd., on the basis of gravity work. A drilling barge with a rotary rig mounted on it was originally brought up from Louisiana to drill these wells; but because of the expense involved, drilling from wooden frameworks with

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cable tools was resorted to in later wells (in approximately 15 ft. of water). Gas production was found in the Guelph-Lockport formation at a depth of 1,465 ft.; the wells have open-flow rates of about 250 M.c.f. per day at 600 psi. formation pressure. Pan Western is reportedly planning to drill in Lake St. Clair soon.

... **Area 3** in Fig. 2 indicates the acreage taken out by various operators in search of production in the Salina-Guelph dolomite (Silurian), Trenton limestone (Ordovician), and basal beds (Upper Cambrian).

The presence of Salina-Guelph production does not seem to be related necessarily to the Cincinnati arch, although this area is situated on the arch or on its flanks. The Trenton limestone in Ontario tends to become somewhat dolomitized toward the southwest, the dividing line probably occurring somewhere in the west end of Lake Erie. Dover field produces oil and gas from a faulted syncline in the Trenton limestone, so that there is production from this horizon in Ontario. It was discovered in 1917 and produced 11.45 billion cubic feet of gas to the end of 1955. Correlatively there would be favorable prospects for production in the Trenton in the offshore acreage underlying the west end of Lake Erie.

The sands of the basal beds, although relatively untested, have yielded some interesting oil and gas shows and, on occasion, have reportedly flowed sand to surface. Exploratory drilling in Area 3 is thus conducted toward location of pinchouts and draping of the basal beds against the Cincinnati arch. The old Shanks well immediately west of Tilbury field, produced 16 bbl. of oil per day for about a year from Mount Simon-Upper Cambrian sandstone.

... **Area 4** in Fig. 2 indicates where companies have taken out acreage with a view to locating Salina-Guelph production, as well as shallow and prolific oil fields similar to the Rodney pool and Petrolia oil pools, in the vicinity of the Erie trough. In such a salt-bearing area, gravity interpretation apparently is made more reliable in the location of Salina and Guelph structures. There are possibilities for Mount Simon production in this area also.

... **Area 5** in Fig. 2 represents the so-called low-pressure offshore play. Here operators hope to find near-virginal reservoir conditions in drilling opposite 70 miles of near-continuous gas production on land. Gas is sweet and is produced from three zones: the Clinton (Thorold), Grimsby, and Whirlpool formations. Flows are generally small, 20-200 M.c.f.d., sometimes higher (2,000 M.c.f.d.).

Depth of water precludes other companies from offsetting production on the lakeward side to drain near-shore gas wells which might be drilled. Ready markets with carrier systems already in existence and pumping stations at convenient intervals along shore, in conjunction with shallow depth and reasonable drilling costs, make this gas play economically attractive. Gas brings 35-45 cents per thousand cubic feet to the producer.

... **Area 6** in Fig. 2 shows the Clinton gas-field-trend play (Fig. 1). This acreage was taken out with the idea of developing the possible extension of the Clinton gas-field trend passing through Lake Ontario to join Clinton production from the Ohio side of Lake Erie. There would be a good possibility of finding a really large gas field on this acreage (as in Ontario) and with good reservoir characteristics (higher pressures and gas-flow rates) approaching those of the Clinton gas fields in the vicinity of Cleveland, Ohio. A few wells drilled on this block would probably prove or disprove the theory. Gas production is characteristically sweet, free of water problems, and brings 35-45 cents per thousand cubic to the producer.

... **Area 7,** not shown on the map, is considered to be the offshore acreage to be put up for public tender by the Ohio and Pennsylvania govern-

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ments. This acreage offsets gas production on land with large potential market from the Cleveland, Ohio, and Erie, Pennsylvania, areas. The Ohio Government reportedly will not be ready to offer this acreage to the oil and gas industry for several months yet. The Pennsylvania Government held its initial lease sale on September 24 on two blocks totaling 35,710 acres.

Offshore Drilling in the Eastern Great Lakes Region

Offshore drilling methods . . . Cable-tool rigs are used almost exclusively for well drilling in southern Ontario, being tried and proved and relatively inexpensive. Rotary rigs are sometimes used for high-pressure-well completions, as in the case of the pinnacle reefs. The rotary rig loses its time advantage in drilling through the Detroit River formation which contains much chert over a 300-ft. section. Also, lost-circulation troubles are met in the Detroit River formation.

Sectional steel towers, usually 85 ft. in height, are preassembled and set over location by a crane-equipped barge. Lake-bottom conditions must be carefully appraised, and for a successful drilling operation, much depends on setting the tower upright and keeping it vertical and on guying it adequately. In some locations up to 15 ft. of ooze makes matters difficult.

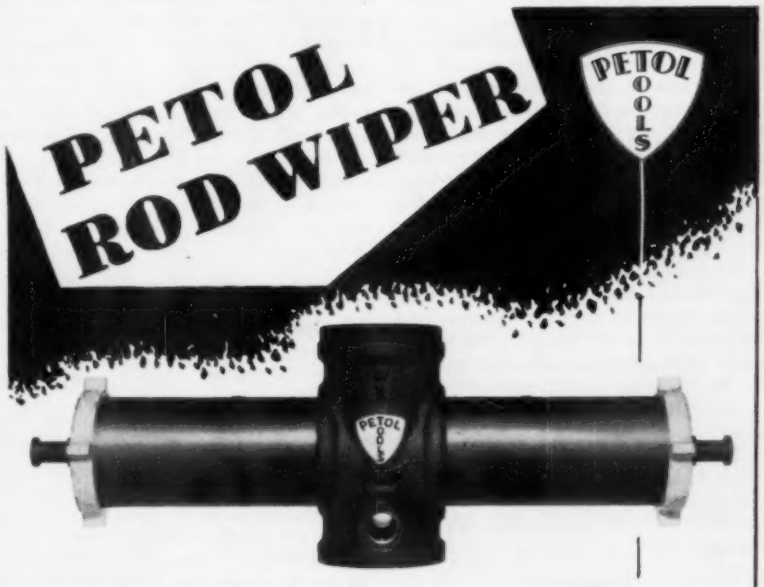
The corners of the towers are suitably guyed to four piles driven into the lake bottom, approximately 100 ft. away from each of the four corners. A cable-tool rig and equipment, sleeping hut, and cookery are placed on top and drilling progresses normally. The marine end of operations (servicing and handling of men and equipment, the use of a diver) constitutes the main difference from ordinary land operations; this is why offshore-drilling costs run anywhere up to 50 per cent more than comparable drilling on land. These costs are being cut down by improvements and innovations and by volume drilling.

Wellheads, pipelines, and connecting flow lines remain on the lake bottom out of reach of the ravages of storm and drifting ice in the winter and of navigation in the summer. The drilling season corresponds to the navigation season from the first of May to approximately November 15. Well locations are made by triangulation from shore with the use of telescopes and a boat; the boat steams out one line-of-sight and signal is given to the boat by radio communication to drop the marker buoy when the second line-of-sight is intersected.

Wells in the Tilbury underlake gas-field extension are drilled to an average 1,250-ft. depth. Depth of water varies 30-75 ft. although present equipment can be used to drill practically anywhere in the western two-thirds of Lake Erie (Fig. 1). The deepest point in the lake is 210 ft., immediately to the east of Long Point, so that some parts of the east end of the lake would be inaccessible to the drill with present equipment. Initial gas flows in the Tilbury gas field and underlake extension range up to 3,000,000 cu. ft. per day at 200-600 psi. formation pressure.

Reservoir conditions improve lakeward approaching virginal pressures offshore. Low-pressure wells are completed barefoot leaving as much as 400 ft. of open hole above the pay section.

One company's new floating type of tower was tried but met with bad luck, listing and sinking to bottom in about 30 ft. of water. The bottom section was floated out to location, sea cocks were opened and framework was submerged on the spot; the top section was then floated over and legs were lowered into bell housings on the bottom section by means of jacks. However, when one pontoon was removed the tower reportedly developed a list which resulted in its overturning. The operators expect to recover the equipment and have it



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operating again soon. Another company's portable tower toppled and fell into the lake in November 1956, during a bad storm. Equipment was recovered and is back in use.

Water Pollution and the Fishing Industry

Operators are exercising extreme care in avoiding pollution of the freshwater lake. Recovered oil and spent acid are placed in tanks and returned to shore. Drill cuttings are dumped in the lake, being harmless and insignificant in amount. Sulfur water found in porous zones is cased off. Sometimes the production string is cemented to the lake bed, making a very effective seal; otherwise a bottom-hole packer is used.

The fishing industry has shown concern over the encroachment of the drilling rigs on the fishing ground, on the assumption that the movement of boats and the noises associated with drilling operations would drive away the fish. There is no evidence to support this theory and, in fact, the catches reportedly have been just as good near the rigs as beforehand. On occasion drifting nets have been caught on buoy-supported cables (attached to pile-points driven in the lake bottom) and have had to be cut away by the fishermen. This problem will be overcome by the removal of the pile-points and cables after drilling operations have ceased.

The effects of the lamprey eel and other fishing hazards have made the fishing industry wary of any man-made interference with their means of livelihood.

Economics

Approximately 30 billion cubic feet of natural gas was marketed in Ontario in 1956. The Gordon Report anticipates an expansion to 15 times this volume by 1980. Ontario is fuel hungry, and although the completion in 1958 of the Trans-Canada Pipeline to eastern Canada from Alberta will assist greatly in meeting these increased requirements, there will always be a large demand for a domestic supply.

The following tables give an interesting comparison of Alberta and Ontario oil production and exploratory drilling:

Oil Production in Canada

Province	Daily aver. bbl.	Annual total bbl.	Ttl. prod. oil wells at end of 1956
Alberta	393,196	143,909,641	7,390
Ontario	1,621	593,287	1,422

Wells Completed in 1956

Province	Oil	Gas	Dry	Total	Footage
Alberta	1,368	138	386	1,892	10,093,579
Ontario	57	157	217	431	513,884

Ontario production is thus relatively small, but despite this fact, these figures could more fairly be multiplied by several times, owing to their economic importance.

The exploration dollar stretches far. Offshore acreage in Ontario, for example, can be held for 3 years for a total $4.35 per acre, which allows for rental payments, required work expenditures, and land acquisition costs. Following this period, the land can be leased for $1 per acre per year rentals. Conditions in this area are well suited to the smaller type of oil and gas operation.

The Ontario offshore oil and gas play, in particular, offers the operator cheap acreage in rather large blocks, in an economic area with ready and available markets. Relatively cheap operating costs added to the prime requisites of suitable source rocks, reservoir rocks, and the presence of suitable structural and stratigraphic conditions for the entrapment of gas and oil (especially in the deeper horizons), provide further incentive for participating in this new phase of development in the industry.

Offshore Legislation

Michigan . . . Current legislation does not permit the drilling of wells for oil or natural gas on the submerged lands or offshore areas of the Great Lakes and connecting water within the boundaries of the State of Michigan.

However, legislation does permit the leasing of submerged lands which lie immediately adjacent to shore if these lands are applied for to complete 10, 20, or 40-acre drilling units. The stipulation is made that wells drilled on such units be located on the upland portion of such units.

There has been much inquiry and there is considerable interest in making the submerged lands available for prospecting and development of oil and gas in Michigan waters.

Government officials state that it is possible that a bill or bills may be submitted to the current legislature which, if passed, would authorize the leasing of the submerged lands by the Department of Conservation.

Ohio . . . The State of Ohio does have existing regulations concerning oil and gas leasing in lands underlying Lake Erie. Regulations stipulate that, generally, areas to be leased shall consist of units of 1.4 sq. miles (more or less) in the form of a parallelogram, the boundaries of which shall be parallel to lines of latitude and longitude. The Natural Resources Commission may limit the number of areas which may be held by any one lessee. Drilling within ½ mile of the shore is prohibited excepting where written permission may be obtained from the Division of Shore Erosion when offsetting a field along shore.

Notice of any public offering to lease such lands by competitive bidding by sealed tender will be made in one of the weekly oil and gas journals and in a daily newspaper for 30 days beforehand. Bids will be opened publicly; award will be made to the bidder offering the highest cash bonus; bids must be accompanied by a certified check.

Proof of United States citizenship must be shown by an individual and by partners, if a partnership, and a certificate from the office of the Secretary of State showing the right to do business in the State of Ohio shall be required, if a corporation.

Royalty is set at one-eighth of current wellhead value of any gas or oil; rentals of 50 cents per acre are payable semiannually in advance, on May 1 and November 1 in each and every year. Rentals are abated on every 40 acres with a producing well. There is a 1-year well commitment on each lease, which runs for 5 years and as long thereafter as commercial production is obtained.

A $25,000 surety bond must be posted with the Division of Shore Erosion before each well is commenced and until the well is plugged to insure compliance with conditions specified. The Chief of the Division may increase or decrease this amount. Leases may be transferred only with the written consent of the Chief, the Director of Natural Resources, and the Natural Resources Commission.

Drilling and development programs must be submitted to the Division of Shore Erosion for acceptance. Generally, casing will be required the entire length of the hole. Information thus submitted will not be released to the public until the Chief of the Division of Shore Erosion deems it advisable.

The regulations include pollution, fishing rights, other minerals, other government agencies, federal, state, and local laws, keeping of production records, well abandonment, and inspection of area and records.

Pennsylvania . . . Legislation has recently been introduced giving the Department of Forests and Waters jurisdiction over oil and gas leasing offshore in Pennsylvania's portion of Lake Erie.

An offshore lease form has been prepared with the same general clauses as those of the standard lease form in use for state forest land. This has been modified to meet the particular requirements of offshore operations; no interference with fishing or navigation

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will be permitted, nor will pollution be allowed. Blocks of acreage are laid out on latitude and longitude coordinates at specific distances offshore. An 18-month drilling commitment (Ordovician-Trenton test) is required for the first well, but, the initial well can be completed in a shallower horizon with written approval of the department, if gas or oil are found in marketable quantities.

However, in this event, a second well is required during the same lease year and as long as commercial production of oil or 1,000,000 + cu. ft. per day gas wells are obtained, there is a one-well commitment per lease year. These conditions may be waived by the department with the approval of the governor, if proved impractical.

Areas may be advertised for lease either at the sole instigation of the department or after approval of a request for a particular area.

A one-eighth royalty (at the wellhead) is used and bids are received on a ground rental per acre per year basis, if the area is strictly wildcat. If it is development acreage, rentals will be $5 per acre per year and bids will be received on a royalty basis. Leases shall remain in effect for 10 years and for as long thereafter as commercial production shall be obtained. Drilling is not permitted within ½ mile of the shoreline excepting where special permission may be given by the department to offset a field or pool along shore. Provision is also made for conducting offshore seismic surveys.

The lease form states that the Commonwealth of Pennsylvania is considered to be the owner of the offshore oil and gas rights, but makes no warranty as to the presence of oil or gas nor as to the ownership thereof and lessee assumes the risk of proving title. Also, that in the event that the commonwealth does not have title to all or part of the mineral rights on the land leased, such lack of ownership will not be grounds for reimbursement of any sums of money paid pursuant to the terms of the lease.

First Lease Sale

The initial lease sale was held September 24, 1957, on two blocks of offshore acreage comprising 19,130 acres and 16,580 acres respectively.

New York . . . New State State has no legislation governing oil and gas exploration work in lands underlying Lake Erie and Lake Ontario.

Government officials state that information is presently being compiled pertaining to underground storage unitization, and drilling of wells in the offshore waters within the boundaries of the state. This information will be turned over to two different state committees which will decide whether the matter will be introduced in next year's legislation. **End.**

THE AUTHOR

Bryson Donnan is currently completing his second operating season with Consolidated West Petroleum, the pioneer company drilling offshore wells in Lake Erie.

He has had over 8 years of experience in oil and gas exploratory and development work in western and eastern Canada, three of these while being engaged in the consulting field in Alberta. In 1949 Donnan was graduated from the University of Toronto with a bachelor of science degree in mining geology.

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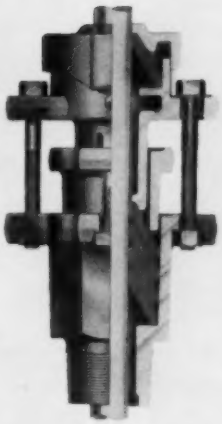

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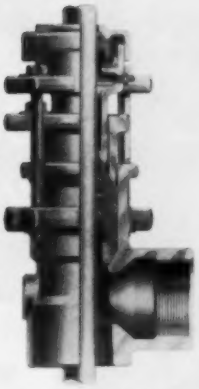

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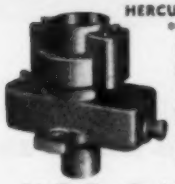

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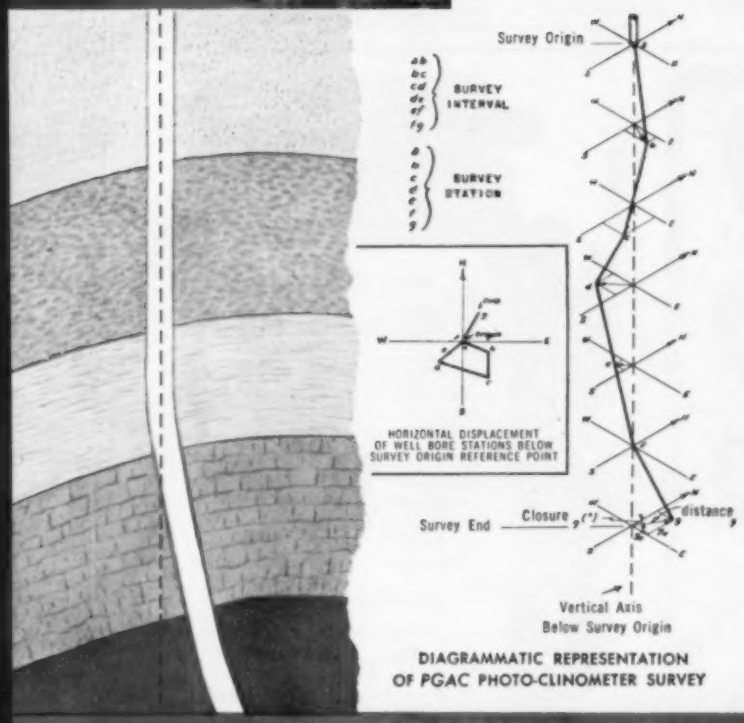

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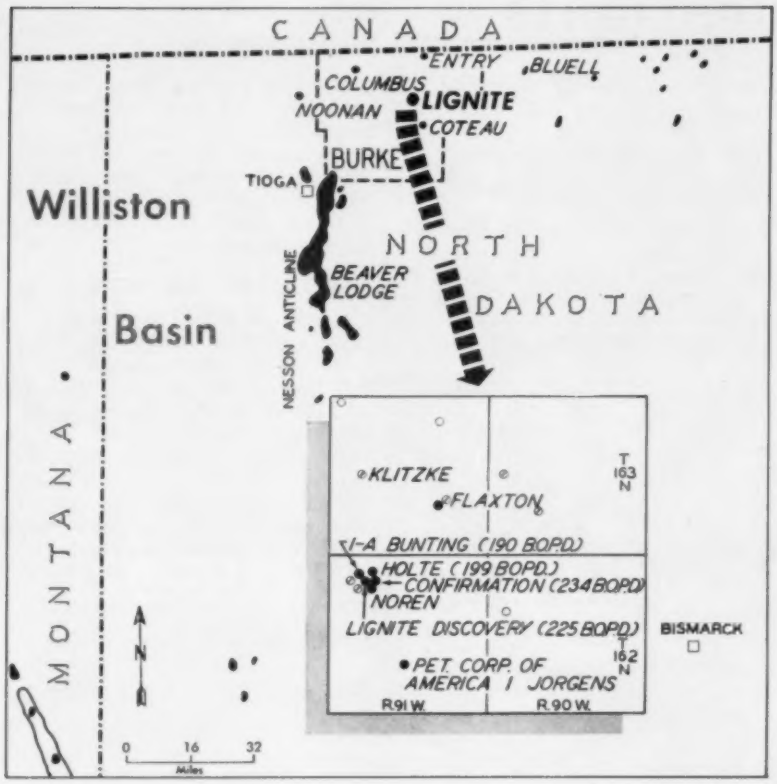

25 new wells search Midale pay as . . .

North Dakota's Lignite Field Stirs Williston Activity

By John C. McCaslin
District Editor

THE search for oil off the Nesson anticline in North Dakota is entering a new enthusiastic period. Focal point for this new Williston basin drilling trend is Burke County, just northeast of the Beaver Lodge and Tioga fields. A current check of drilling in this county reveals 25 active operations, making it the busiest area in the basin. The cause of all this flurry is new Lignite-Mississippian (Midale) field.

A sporadic hunt . . . Exploration off the Nesson anticline since Tioga and Beaver Lodge has paid off here and there in such North Dakota counties as Divide, Burke, Renville, and Bottineau. But most of the fields have been small and in many cases disappointing. Each new field discovery would set off an intensified drilling campaign, only to die on the vine.

Is reborn . . . Several weeks ago Northwest Oil Drilling Co. sparked a new North Dakota and Williston basin drilling spree at 1 Ed Bunting in S½ SE SW 5-162n-91w.

Initial production at this Lignite discovery well was 225 bbl. of oil daily from the Midale-Mississippian, a pay name brought down from neighboring Saskatchewan. The total depth was 6,640 ft.

And mushrooms . . . The Lignite discovery well was followed by rapid development on all sides.

- Northwest Oil Drilling Co. completed the field confirmation well at 1 Holte in C SE SE 5-162n-91w for 234 bbl. of oil per day on 9/64-in. choke.

- Northern Natural Gas Producing Co. completed 1-A Bunting in C NW SW 5-162n-91w for 190 bbl. of oil per day and 25 bbl. of water from Midale perforations at 6,078-6,104 ft. This is a northwest extension to Lignite.

- Pan American Petroleum Corp. completed 1 Holte in C NW SE 5-162n-91w for 199 bbl. of oil daily, extending the field to the north. Flow was through perforations in the Midale at 6,066-94 ft. on 19/64-in. choke.

- Northwest Oil and Central LeDuc are nearing completion at 1 Klitzke, an apparent discovery 4 miles north of Lignite field in C SW SW 17-163n-91w.

- Petroleum Corp. of America and Tom Jordan have an apparent strike at 1 Jorgens in C NE NE 28-162n-91w, about 3 miles southeast of Lignite proper.

- Mobil Producing Co.'s 1 Noven, a southeast offset to the discovery well in C NW NE 8-162n-91w, is also a Midale success.

The new Burke County activity could well be the drilling surge North Dakota has been waiting for. Drilling depths here are shallower than on the Nesson anticline even though they are deeper than the pay sands of the Williston's northeast rim in Bottineau County. But the potentials at Lignite wells are among the very best in off-Nesson production. Burke County's success very likely may give North Dakota an active exploratory and development agenda for 1958.

A recent Burke County land sale brought a $71.50 bonus. Northern Natural Gas Co. gave this per acre for Burke County lands 12 miles west of Flaxton field at a school land sale in Bismarck on September 25. This was the sale's highest bid, and is much higher than previous bids for lands east of the Nesson anticline (see North Dakota section in this issue for late drilling report).

EXPLORATION THIS WEEK

Appalachian	316
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Rocky Mountains	320
Texas	321
Successful Wildcats	324

EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Clinton Gas Tapped At Roseville Oil Field

A step-out of 1 mile from oil production at Roseville found gas in the top of the Clinton. Producers 1 W. T. Carr, Section 35, Newton Township, Muskingum County, topped the sand at 3,640 ft. and drilled-in to 3,650 ft. with an open flow of 1,780,000 cu. ft. natural.

New Gas Pool Indicated At Lake Township Well

A new gas pool is indicated in the northeast part of Lake Township, Ashland County. Roy Stewart et al 1 G. P. Long, Section 11, logged Clinton at 3,072-3,102 ft. with 230,000 cu. ft. natural and 4,250,000 cu. ft. after fracture.

SOLVED: *The Case of the "Tired" Drill Pipe*

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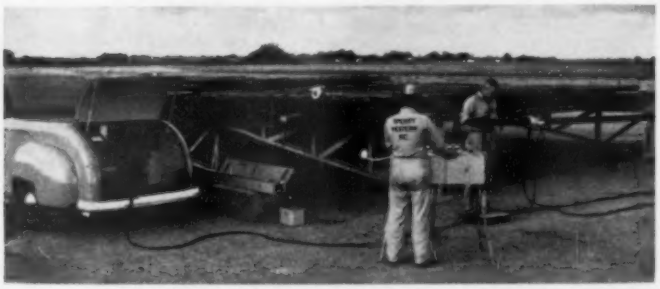

INDUCTOGRAPH testing of drill pipe: Internal and external defect information, obtained by self-propelled magnetic induction unit, is transmitted to permanent record tape.

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Second New Castle Well Comes In

A second producer in the extreme north part of the New Castle pool was brought in. Preston Oil Co. 1 Clyde Wolfe, second quarter, New Castle Township, Coshocton County, filled up 100 ft. natural from Clinton at 2,911-73 ft. and made 175 bbl. in a 24-hour test after fracture.

EASTERN KENTUCKY

Columbian Fuel Corp. have completed a good gas well at their 1 Raymond Mayhorn on Poundmill Run on Tug River in Pike County. Bottomed at 2,400 ft. in Mississippian Big lime test gaged initially at the rate of 19,548,000 cu. ft. of gas daily. Pay was had from 2,385 to 2,400 ft. with top of formation logged at 2,080 ft. Well was completed naturally and a 3-day rock pressure test checked out at 705 psi.

CALIFORNIA

Nealy Extends Kern River

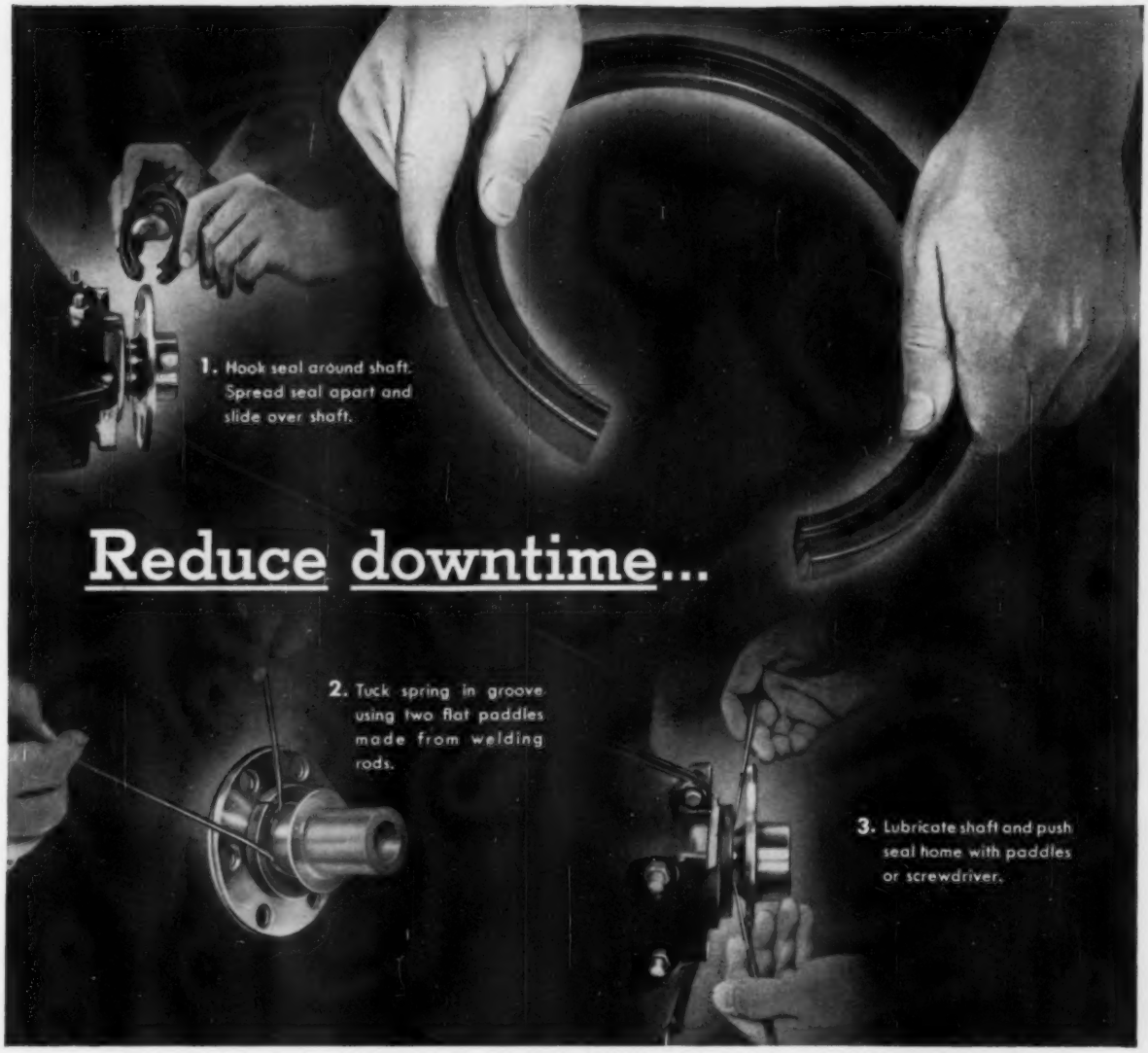
Nealy Exploration Co. completed an extension test on the south flank of the Kern River field in Kern County. The new well, 2 Hotchkiss, was completed on the pump for 35 bbl. daily of 13°-gravity crude from 640 ft. The test was originally taken to 900 ft. and then plugged back to 640 ft. for the completion. It is in SW NW 10-29s-28e.

Bridge Area Extended

The Texas Co. scored with an extension on the east flank of the Bridge Pool area-South Mountain field in Ventura County. Texaco dually completed the well, 29 Harvey, in two zones at 7,952-8,052 ft. and 8,340-9,028 ft. Initial production was flowing 723 bbl. daily of 31.3°-gravity crude through a 29/64-in. choke. Location of the well is in NW NE 13-3n-21w. Total depth was 9,115 ft.

New Cat Canyon Well

Bishop Oil Co. moved out ¾ of a mile southeast of East Cat Canyon field production in Santa Barbara County in drilling an important test. The new well, 1 Williams Holding Co., was tested at an interval at 2,030-2,280 ft. Gas surfaced in 3 minutes and it flowed oil cut gassy mud and gas at 500 M.c.f. daily. The fractured shale zone, upper Miocene, was found at 2,000 ft. Bishop was preparing to run a formation test on another interval at 2,790-2,830 ft.


1. Hook seal around shaft. Spread seal apart and slide over shaft.
Reduce downtime...
2. Tuck spring in groove using two flat paddles made from welding rods.
3. Lubricate shaft and push seal home with paddles or screwdriver.

How J-M Split Clipper Seals speed installation

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CANADA

ALBERTA

Phillips B-1 Kaybob Finds Beaverhill Lake Dry

The Iosegun River-Kaybob area of northwestern Alberta held the spotlight in western Canadian oil operations again this week as Phillips Petroleum Co. penetrated the Beaverhill Lake-oil producing sector at its initial follow-up well in the area without encountering porosity; while the California Standard Co.-British American Oil Co., Ltd.'s Iosegun discovery well flowed oil during another drill-stem test and has now also fully evaluated the Beaverhill Lake formation.

Although the Phillips follow-up B-1 Kaybob, on LSD 5, 6-64-18w5, was dry in the Beaverhill Lake structure, hope has not been given up on it from other formations. This is pointed out by the presence of casing in the hole and the firm is currently carrying out production test operations in the Winterburn zone, also a member of the Devonian age. This test was drilled 5 miles southeast of the initial strike in the area by Phillips and is the same approximate distance east-northeast of the Iosegun wildcat discovery. It was also reported by the operator that after evaluations are completed in the Winterburn further testing operations uphole will also be carried out.

Meanwhile, at the Cal Standard-B.A. 7-33-63-19 Iosegun River well, on LSD 7, 33-63-19w5, the discovery zone, which flowed oil at the rate of 3,120 bbl. per day through a ½-in. choke, has been fully evaluated and casing will now be run. It is not known, however, if the venture will be carried down to evaluate lower horizons, nor is it known what the thickness of pay was. Another drill-stem test was run immediately below the interval taken in by the discovery evaluation and a total of 125 ft. was thus covered by those operations. The second test, a 69-ft. section below 9,911 ft., flowed oil to surface in 77 minutes and when turned to separator, showed a recovery of 50 bbl. of crude in 1 hour with a gas-oil ratio of 1,240 cu. ft. per barrel.

Tempo of operations is expected to speed up in this area, as well as the Virginia Hills-Swan Hills region, the two of which now boasts five oil wells in a structure previously unknown for commercial production, with the coming freeze-up. Although no plans have been announced by any firms in this respect, the area stands out as one of the hottest in the northern sector of this province, since Red Earth Creek.

LOUISIANA

SOUTH

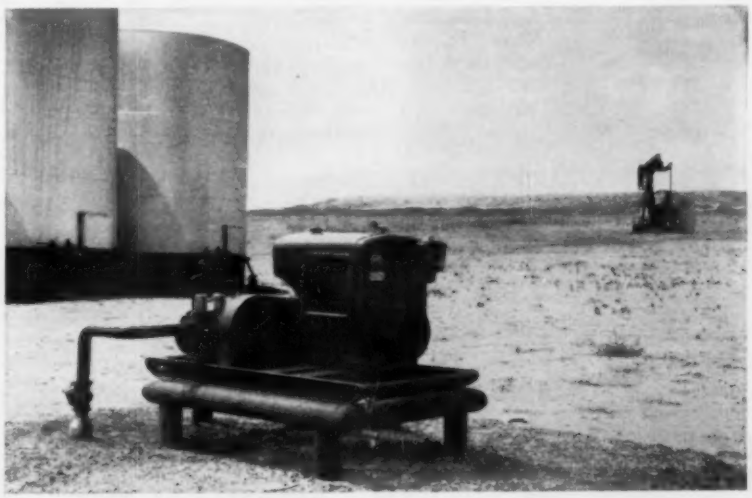
Deep Production Opened In New Cyprian Bay Area

Tidewater Oil Co. has what appears to be an important discovery well in the Cyprian Bay area, 4 miles southwest of Buras in Plaquemines Parish's delta marshes.

Its discovery well, 1-A Abercrombie, is about 3 miles east of the deep, multiple-pay gas-condensate production being developed by Tidewater and Pan American Petroleum Corp. in the Bastian Bay area.

The well, now shut in pending further development of the field tested 4,698,000 cu. ft. of gas per day, flowing through 5/32-in. choke. Pressures were 8,100 psi., flowing, and 8,700 psi., shut in. Its pay is perforated at 13,652-58 ft.

Humble Oil & Refining Co., Gulf Oil Corp., and J. S. Abercrombie have working interests in the discovery. This is the second test for the immediate area. The first, 3 miles south, was dry at 14,990 ft.



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MICHIGAN

Two Shallow Tests Promise New Fields

Two shallow tests appeared pool openers in widely separated districts of Michigan. Clem Glavin's 1 Clabeusch SE NE SE 7-14n-5w, Isabelle County, gaged 2,100,000 cu. ft. from sand section at 1,318 to 1,341 ft.

- In Oceana County Robert Bond 1 Cloud, NW SW NE 16-16n-16w, Crystal Township, showed estimated 6,000,000 cu. ft. gas in Dundee dolomite at 2,378 to 2,388 ft.
- McClure Oil Co. will drill 5,300 ft. wildcat to test Salina and St. Peter sand sections in old Hope (Traverse lime) field of Barry County on 1 Hibbard, SE SW NE 34-2n-9w.

Proration Considered For Scipio Field

A public hearing has been called for October 17 in Lansing to consider establishing state proration on the new Scipio field, Hillsdale County. Hearing will be before State Well Supervisor Gerald Eddy and the Oil Advisory Board.

Four 3,600 to 3,900-ft. Trenton lime oil wells currently are producing in the field on a voluntary limit of 150 bbl. per day. Two other wells are drilling and at least six tentative locations have been made. A one well to 40 acre pattern was established earlier.

NORTH DAKOTA

Fifth Well Added to New Lignite Field

Lignite field in Burke County continues to grow rapidly. The latest and fifth addition to the Midale-Mississippian reservoir is Mobil Producing Co. 1 Noren in C NW NE 8-162n-91w.

The new well flowed 210 bbl. per day on 18/64-in. choke from perforations at 6,094-6,120 ft.

Other field activity includes: Northern Natural Gas Co. is at total depth 6,214 ft. at a west extension; Northern Natural also made location for 3-A Bunting, west of the field; Petroleum Corp. of American et al continue tests at 1 Jorgens; Northwest Oil Drilling Co. and Central LeDuc are testing at 1 Klitzke, another discovery; Atlantic Refining Co. abandoned 1 Falck 2 miles southwest of the Klitzke and 3½ miles northwest of Lignite itself; Arrowhead Exploration 1 Propst, northwest of the 1 Falck, is waiting for completion tools. (See special Burke County feature in this section.)

ROCKY MOUNTAINS

WYOMING

Casper Convention Date Set

The 1958 Rocky Mountain Section meeting of the A.A.P.G. will be held in Casper, Wyo., April 27-30, it has been announced by John F. Partridge, Jr., general chairman of the 1958 convention. Selection of a later-than-usual date was necessary to avoid conflict with the National A.A.P.G. meeting in Los Angeles, March 10-13, and with a late Easter falling on April 13.

This will be the second A.A.P.G. convention for Casper, the first in 1953 under the chairmanship of Bill Curry, retiring president of the Rocky Mountain Oil and Gas Association, having drawn 1,500 persons. Since 1953 Casper has added materially to its convention facilities with a major hotel addition and completion of more than a dozen new motels, most of them in the luxury class.

The 1958 convention sessions will be held in the new Industrial Building at the Natrona County Fairgrounds, 3 miles from downtown Casper. The

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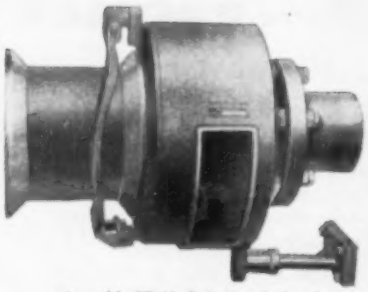
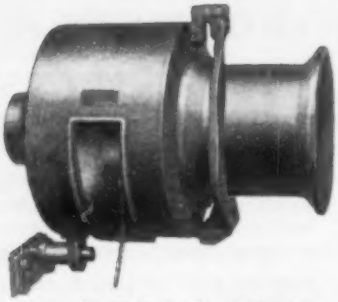


Assembly 37 Air Spinning Cathead



Assembly 24 Air Breakout Cathead

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modern building seats 1,500 persons and is equipped with the latest sound and projection facilities, as well as a lunch room and snack bar. Ample space for exhibits is provided in adjoining buildings. Outdoor space, either covered or open, is also available within a few steps of the Industrial Building.

UTAH

More Oil Recovered At Paradox Wildcat

Continental Oil Co. reports recovery of 3,450 ft. of oil on a second drill-stem test at the 10 Navajo-A in SW NE SW 32-41s-24e, about halfway between Desert Creek and White Mesa fields in San Juan County, Paradox basin.

Coring now is below 5,784 ft. This well flowed oil at the estimated hourly rate of 50 bbl. on a test at 5,663-5,712 ft. There has been no drilling at all between the two mentioned fields.

TEXAS

GULF COAST

New Frio Field Opened In Corpus Christi Bay

Exploration in Corpus Christi Bay has uncovered another new field, productive of gas and condensate. The discovery is by Renwar Oil Corp. and Layton Brown Drilling Co. in State Tract 5, on the north side of the bay, just offshore from San Patricio County, but in Nueces County. It is southeast of East Corpus Christi Bay field, and northeast of Corpus Channel field.

The Renwar-Brown well, drilled to 9,021 ft., is productive from two zones. The shallower is perforated at 7,771-77 ft., and the deeper at 7,969-75 ft. Both are in the Frio section. The upper zone is rated good for 34,000,000 cu. ft. of gas daily, open flow, yielding 55.9°-gravity condensate in the ratio of 47,500 cu. ft. of gas per barrel of liquid. The lower zone tested 16,500,000 cu. ft. per day with a gas-liquid ratio of 34,400 cu. ft. per barrel. Shut-in pressure of each zone is 2,850 psi.

Two New Fields Opened On Wilcox-Yegua Trend

Two new discoveries were reported last week by Sinclair Oil & Gas Co. and Atlantic Refining Co. in their joint wildcatting operations along the upper coastal Wilcox-Yegua trend.

One is in their 1 Brown Fee, in southern Tyler County. The other is in their 1-B Hampton Fee, in adjoining northeastern Hardin County.

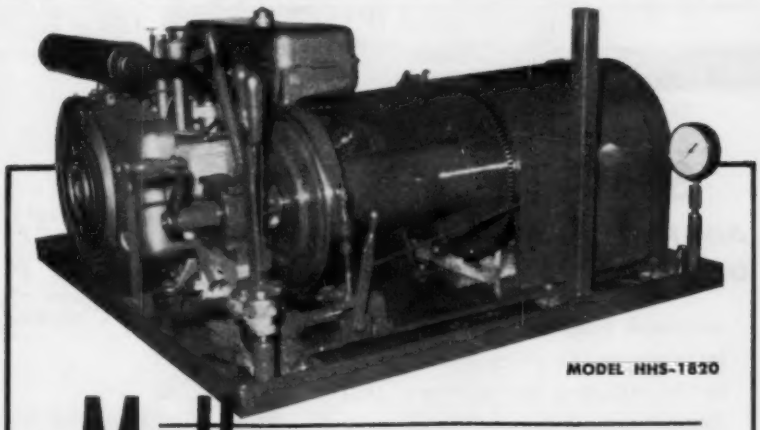
The Tyler well flowed 53.3 bbl. of 44.6°-gravity oil per day through 5/32-in. choke from Wilcox sand, perforated at 8,432-54 ft. Its gas-oil ratio was 1,862 cu. ft. per barrel. Location is about 2 miles south of Housh field, nearest production, 3 miles west of Wurtzbaugh field, and about 4 miles east of Hicksbaugh field.

The Hardin well is perforated opposite two Yegua zones, one perforated at 8,095-8,102 ft., and the other at 8,037-40 ft. The deeper tested 19½ bbl. of 55.1°-gravity condensate with 560,000 cu. ft. of gas per day through 5/32-in. choke. The upper had a flow rate of 1,380,000 cu. ft. of gas and 24 bbl. of 53.8°-gravity condensate per day through ⅜-in. choke. Its location is 2 miles northeast of South Hampton field.

TEXAS PANHANDLE

New Atoka Pool Opened in Hemphill

Another Pennsylvanian gas pool was opened in Hemphill County last week at Magnolia Petroleum Co. 1 Olive T. Jones. The northeastern Hemphill wildcat, 11 miles northeast of the town of Glazier and about 1½ miles north of a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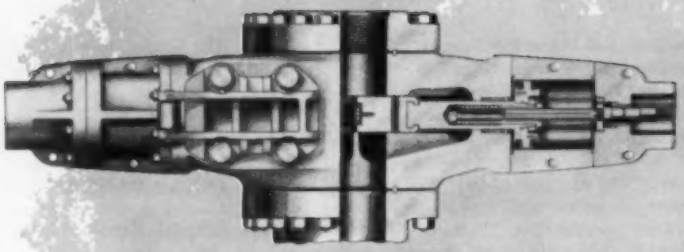
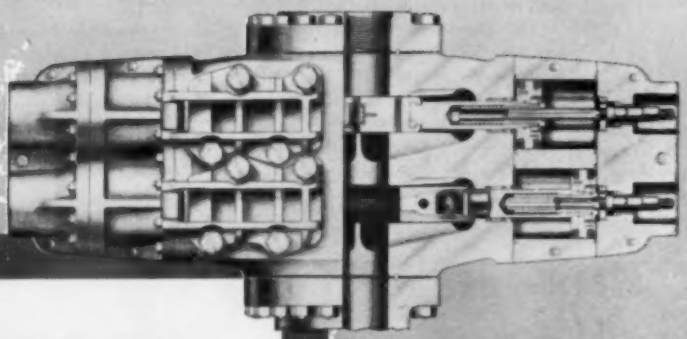


Here's the Shaffer Hydraulic SINGLE Cellar Control Gate with *Non-Rising* Locking Shafts for maximum compactness. You can use this Gate either alone, in assemblies of two or more, or in a combination hook-up with the Double Gate shown below.



And here's the Shaffer Hydraulic DOUBLE Cellar Control Gate with *Non-Rising* Locking Shafts—the gate that unitizes *two* ram compartments into *one* compact body. Note how both the Single and Double designs have the same unique *side-opening* doors for unequalled convenience in changing rams!

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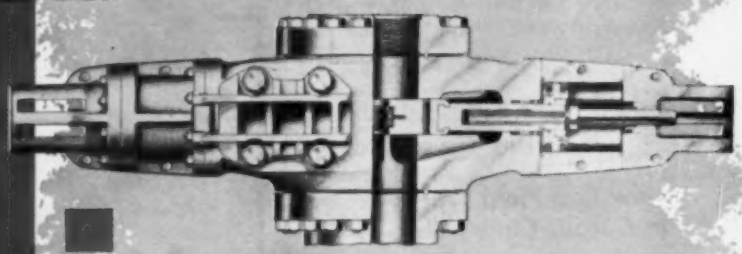
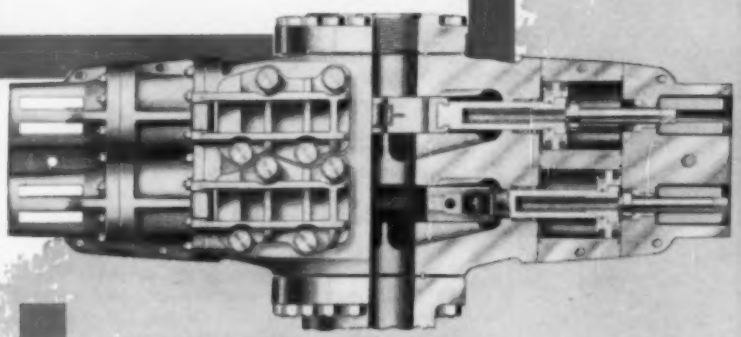


And here's the Shaffer Hydraulic SINGLE Cellar Control Gate with *Rising* Locking Shafts for maximum ease in checking ram position. It has the same advanced design as the units above—and most parts are interchangeable, size for size, thus simplifying inventory requirements.



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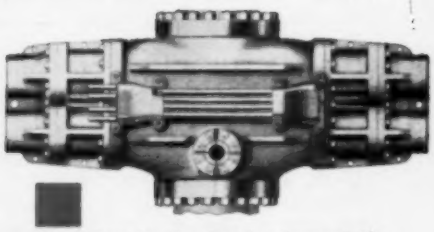

And here's the back view of the Double Gates. No matter which of the four Gate designs you select, the hydraulic manifolding is as simple and clutter-free as shown here—and they can be had with built-in outlets to eliminate spools in the hook-up.

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recent lower Tonkawa-Penn gas discovery at 1 D. D. Feldman, flowed at the rate of 10,300 M.c.f. of gas per day plus 6 bbl. distillate per million from deep perforations at 10,453-67 ft. Location is in Section 5, Block 43, H&TC Survey.

WEST TEXAS

Deep Wildcat Scheduled In Terrell County

Hunt Oil Co. has announced location for a 15,000-ft. wildcat to be drilled 26 miles northeast of Thurston, in northeastern Terrell County. The test will be 1 Bustin Cannon, located in NW SE Section 5, Block 1, TCRR Survey.

Devonian Oil in Spraberry Trend

Tex Harvey Oil Co. has recompleted its 1-16 B. W. Floyd as a Devonian discovery along the northwestern flank of the Spraberry Trend fields in eastern Midland County. Location is in Section 16, Block 37, T3S, T&P Survey, 18 miles southeast of Midland.

Completion potential from the Devonian at 11,193-11,512 ft. was 361 bbl. of 43°-gravity oil a day. Choke size was 3/8-in., and gas-oil ratio was 3,238:1. The well was originally drilled dry to 12,063 ft. as an Ellenburger test, then plugged back to become the discovery well for the Tex-Harvey portion of the trend.

Nearest Devonian production is about 4 miles to the northwest in Azalea field.

According to some operators, this new deep pay can hardly be construed as another payout possibility for the Spraberry Trend fields, in the same sense as recompletions, or dual completions, with the Clear Fork as a second pay.

While exploration for the deep pay may be encouraged by this well, any drilling program to that depth would require a new hole since the normal casing program on a Spraberry well would not accommodate the additional depth necessary to reach the Devonian.

Third Pay Added to Andrews County Field

Devonian has been added as the third pay in Tripple N field in southern Andrews County at Gulf Oil Corp. 1-BM State, a depleted Ellenburger producer.

The new-pay opener flowed 202 bbl. of oil a day through 20/64-in. choke from perforations at 10,600-10,735 ft., after fracture treatment. Total depth was 12,490 ft. The well also may be completed dually from Silurian pay. Location is 11 miles southwest of Andrews, in Section 29, Block 9, University Lands Survey.

Howard County . . . A prolific 1-mile west extension to Vincent-Pennsylvanian field in Howard County has been made at Nortex Oil & Gas Corp. 1 C. W. Shafer, 30-25-H&TC, 20 miles northeast of Big Spring.

The well flowed 663.5 bbl. of oil in 14 hours through 24/64-in. choke, from perforations at 7,516-21 ft. Pay was also indicated in the Clear Fork at 4,558-64 ft.

Location is 1 mile west of Woodson Oil Co. 1 Pauline, discovery and only producer in North Vincent (Pennsylvanian) field. The opener was completed in May for 1,195 bbl. of oil a day from the reef at 7,448-70 ft.

Crane County . . . A second deep producer for the Dune field of Crane County has been assured at Gulf Oil Corp. 2 Adams, 12-B24-PSL Survey, 11 miles northwest of Crane.

On a test at 7,704-52 ft., identified as Wolfcamp or Permo-Pennsylvanian, the well flowed 139 bbl. of 40°-gravity oil in 3 hours. Flowing pressure ranged from 1,335-95 psi. Drilling continued on an 8,200-ft. contract.

Location of 2 Adams is 1 location

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southeast to the field discovery, which completed in May for 1,891 bbl. of oil a day at 7,710-60 ft.

SOUTHWEST TEXAS

Hidalgo Discovery Makes Good Flow on Potential

The discovery well completed by Slick Oil Corp. and Harrell Drilling Co. southwest of Donna, in Hidalgo County, flowed 163.23 bbl. of oil per day through ⅞-in. choke. Flow was with gas-oil ratio of 1,425 cu. ft. per day and pressure of 475 psi. Pay is perforated at 5,280-90 ft. in Frio sand.

The discovery opens a new producing area. It is 2 miles south of production in Donna field, but there is a pinchout between them. The well is the operators' 1 Frank Schuster.

San Miguel Creek Gets New Deep Edwards Test

San Miguel Creek field, in northern McMullen County, where the present deep Edwards development through McMullen and LaSalle counties had its inception, in 1953, is getting its first confirmation test for the deep Edwards production found there.

It will be by Humble Oil & Refining Co., which drilled the original deep Edwards well, 1 Gas Unit. That well has not been produced, and no additional deep drilling has been done there until now.

Humble's new location is about 1 mile southeast of its discovery well. It is listed as 1-C Louis M. Gubbels, with location in Section 33, J. M. Hernandez Survey, A-224. Humble proposes to carry the hole to 12,000 ft. Its discovery well was completed in an Edwards crevice zone perforated at 10,149-82 ft.

SUCCESSFUL WILDCATS

ALBERTA

Imperial et al 11-21-39-26 Joffre, LSD 11, 21-39-26w4. TD 7,020 ft. D2 oil well.

Union 2-30-52-25 Acheson East, LSD 2, 30-52-25w4. TD 5,710 ft. Basal quartz oil well.

Mickelson-Pepper 13-36-33-9 Veteran, LSD 13, 36-33-9w4. TD 4,000 ft. Indicated Viking oil well.

White Rose Supertest 8-14-49-5 A'sike, LSD 8, 14-49-5w5. TD 6,005 ft. Cardium oil well.

Phillips A10-20-59-10 Blueridge, LSD 10, 20-59-10w5. TD 5,800 ft. Blairmore gas well.

Honolulu et al 7-23-56-8 Paddle River, LSD 7, 23-56-8w5. TD 5,350 ft. Nordegg gas well.

SASKATCHEWAN

Merrill Shell 4-6 Cactus Lake, LSD 4, 6-36-27w3. TD 2,846 ft. Indicated Detrital oil well.

Mobil Oil Woodley Sinclair X9-5 Southillerbrun, LSD 9, 5-10-18w3. TD 4,595 ft. Shaunavon oil well.

BRITISH COLUMBIA

Pacific 93 Charlie Lake, LSD 13, 5-84-18w6. TD 6,525 ft. Gething oil well.

Gulf States 4 Gundy Creek, LSD 4, B-94B-16. TD 7,018 ft. Triassic gas well.

Phillips A-3 Kobes, Unserveyed B.C. TD 7,575 ft. Triassic gas well.

ARKANSAS

Crawford County: Stephens Producing Co. and Gulf 1 Maggie Turner, NW NW NE 33-9n-30w. IP 5,200 M.c.f. of gas per day, Atoka sand 4,854-74 ft. TD 5,475 ft. New pay in Kibler-Williams field.

Lafayette County: C. G. Davis 2 M. Brown estate, SWc NE SW 26-15s-24w. IPP 35 BOPD, 40 BWPD, 20° gravity, Paluxy 2,713-17 ft. TD 2,768 ft. Discovery of Meriwether field.

George Belchic, Jr. and Mercury Drilling Co. 1 Scantland, SWc NW SE 12-16s-24w. IPP 150 BOPD, 14° gravity, Tokio 2,568-72 ft. TD 3,530 ft. Discovery of Sunview pool.

Miller County: E. A. Carter 1 J. B. Dysart heirs, C SE SW SE 30-17s-27w. IPP 51 BOPD, 25.8° gravity, Mooringsport 5,052-57 ft. TD 5,130 ft. Discovery of Jonesville pool.

Union County: Olin Oil & Gas Corp. 1 Fee "K," NWc 4-17s-12w. IPP 75 BOPD,

17.6° gravity, Meakin 2,545-50 ft. TD 3,000 ft. Discovery of Lick Creek pool.

ILLINOIS

Washington County: London Pipe Line Co. 1 Denbauex, SW NE SE 31-2s-1w. IPP 6 BOPD, 30 BW, Benoist 1,463-69 ft. TD 1,469 ft. Discovery of West Ashley pool.

White County: Skiles Oil Corp. 1 Julia E. Miller et al, SE NW NE 18-4s-9e. IPP 51 BOPD, McClosky 3,468-71 ft. TD 3,545 ft. Extension to Burnt Prairie pool.

Williamson County: Gulf Oil Corp. 1 Henry Mitchell, SW SW SE 21-8s-4e. IPP 186 BOPD, 30 BW, Aux Vases 2,885-2,912 ft. McClosky 2,988-92 ft. TD 3,150 ft. New pay (McClosky) in Corinth pool.

Wabash County: Dee Watson Drilling Co. 1 Sharon Seibert, SE SE NE 14-1n-14w. IPP 148 BOPD, O'Hara 2,831-36 ft. TD 2,836 ft. Extension to Gards Point pool.

KANSAS

Graham County: ORA and Ted Gore 1 Conness, NW NE SE 22-10s-23w. IPP 6 BOPD, 39° gravity, Lansing-Kansas City 3,787-3,808 ft. TD 3,870 ft. Discovery of Conness pool.

Barton County: Thunderbird Drilling Co. 1 Peter Paul, NW NW SW 29-18s-11w. IPP 82 BOPD, 10 per cent water, 41° gravity. Lansing 3,192-96 ft. TD 3,454 ft. Discovery of Northwest St. Peter pool.

Nadel & Gussman 3 Birzer, SW NE NW 3-19s-11w. IPP 180 BOPD, 29.6° gravity, Topeka 2,870-73 ft. TD 3,390 ft. New pay in Klepper pool.

Kingman County: Petroleum, Inc. 1 Bolinger "B," SE SE NW 29-28s-5w. IPP 172 BOPD, 15 per cent water 39.5° gravity. Miss. 3,897-99 ft. TD 3,959 ft. Discovery of Bolinger pool.

Pratt County: Monsanto and Rine Drilling Co. 1 J. E. Moore, NW NW SE 28-29s-13w. IPP 40 BOPD, 60 per cent water 34.5° gravity. Simpson 4,584-88 ft. TD 4,693 ft. Discovery of Jem pool.

Kingman County: Monsanto 1 Schrock, NE SE SW 31-29s-7w. IP 1,000 M.c.f. of gas per day, Miss. 4,160-75 ft. TD 4,284 ft. Discovery of unnamed pool.

Kiowa County: Francis Oil & Gas Co. 1 Parkin "C," C NW NW 5-30s-18w. IPP 85 BOPD, 40 per cent water, Miss. 4,968-80 ft. TD 5,055 ft. Discovery of Southwest Nichols pool.

Meade County: William Gruenerwald 1 T. B. Hockett, C SW SW 8-31s-29w. IPP 20 BOPD, 5 BWPD, 39° gravity. Morrow 5,390-94 ft. TD 5,660 ft. New field is Hockett.

Sumner County: Richard King, Jr. 1 Plummer, NE NW SE 2-31s-2w. IPP 25 BOPD, Kansas City 3,204-08 ft. TD 3,791 ft. Discovery of South Anson pool.

South Texas Development Co. 1 Nunn, SE NW SE 19-32s-2w. IPP 45 BOPD, 80 per cent water. 43.6° gravity. Simpson 4,278-83 ft. TD 4,283 ft. Discovery of Mayfield pool.

Meade County: Panhandle Eastern O-1 Behnke, C SE SW 29-33s-29w. IPF 624 BOPD, Morrow 5,782-90, 5,803-08 ft., Miss. 5,889-94 ft. TD 5,960 ft. New pay (Miss.) in Singley field.

Sumner County: White & Ellis Drilling Co. 2 B. F. Priddy, NW NW NW 35-33s-1w. IPP 55 BOPD, 43° gravity. Simpson 4,332-35 ft. TD 4,335 ft. Discovery of Priddy pool.

Norton County: Panhandle Eastern O-1 Tucker, C SW NE 19-34s-41w. IP 268 BOPD, Cherokee 4,397-4,408 ft., Morrow 4,674-84 ft. TD 5,250 ft. New field.

KENTUCKY

McLean County: Art Walk 1 Cary, 16-M-28. IP 2,640 M.c.f. of gas per day, Penn. sand 725-43 ft. 743 ft. Extension to Calhoun pool.

Henderson County: Lohman & Johnson and Ashland Oil & Refining Co. 1 Polly Watson, 24-O-22. IPP 1 BOPD, Penn. 1,027-34 ft., 1,045-53 ft. TD 2,763 ft. Extension to West Dixie pool.

Daviess County: J. C. Miller and Wico Oil Co. 1 Mulligan heirs, 6-O-28. IPP 25 BOPD, O'Hara 2,000-08 ft. TD 2,162 ft. Discovery of Sorgho pool.

Breckenridge County: George Baker 1 Wilbur Martin, 20-O-35. IPP 7 BOPD, Cypress 332-45 ft. TD 359½ ft. New pay and extension for McQuady pool.

Fisher & Whitworth 1 (2) Roscoe Blair, 18-P-35. IPP 10 BOPD, Jackson 138-55 ft. TD 155 ft. Discovery of West Balltown pool.

PENNSYLVANIA

Westmoreland County, Mount Pleasant Township: Peoples Natural Gas Co. 4144 W. R. Dillon, elevation 2,013 ft., 9,500,000 cu. ft. gas after fracture. Tully 6,889 ft., Onondaga 7,515 ft., chert 7,534 ft., gas 7,535-7,600 ft. TD 7,645 ft.

Indiana County, Armstrong Township: Columbian Carbon Co. 1-1840 Fred Musser, 643,000 cu. ft. gas after fracture. Onondaga 7,741 ft., chert 7,752-7,875 ft., gas 7,752 ft., Oriskany sand 7,875-7,903 ft. TD 7,905 ft.

SOUTH LOUISIANA

Terrebonne Parish: Superior Oil Co. 1 Terrebonne L. & D. Co., 10-21s-16e. IP 6,049 M.c.f. daily and 303 BOPD, 9/32-in.,

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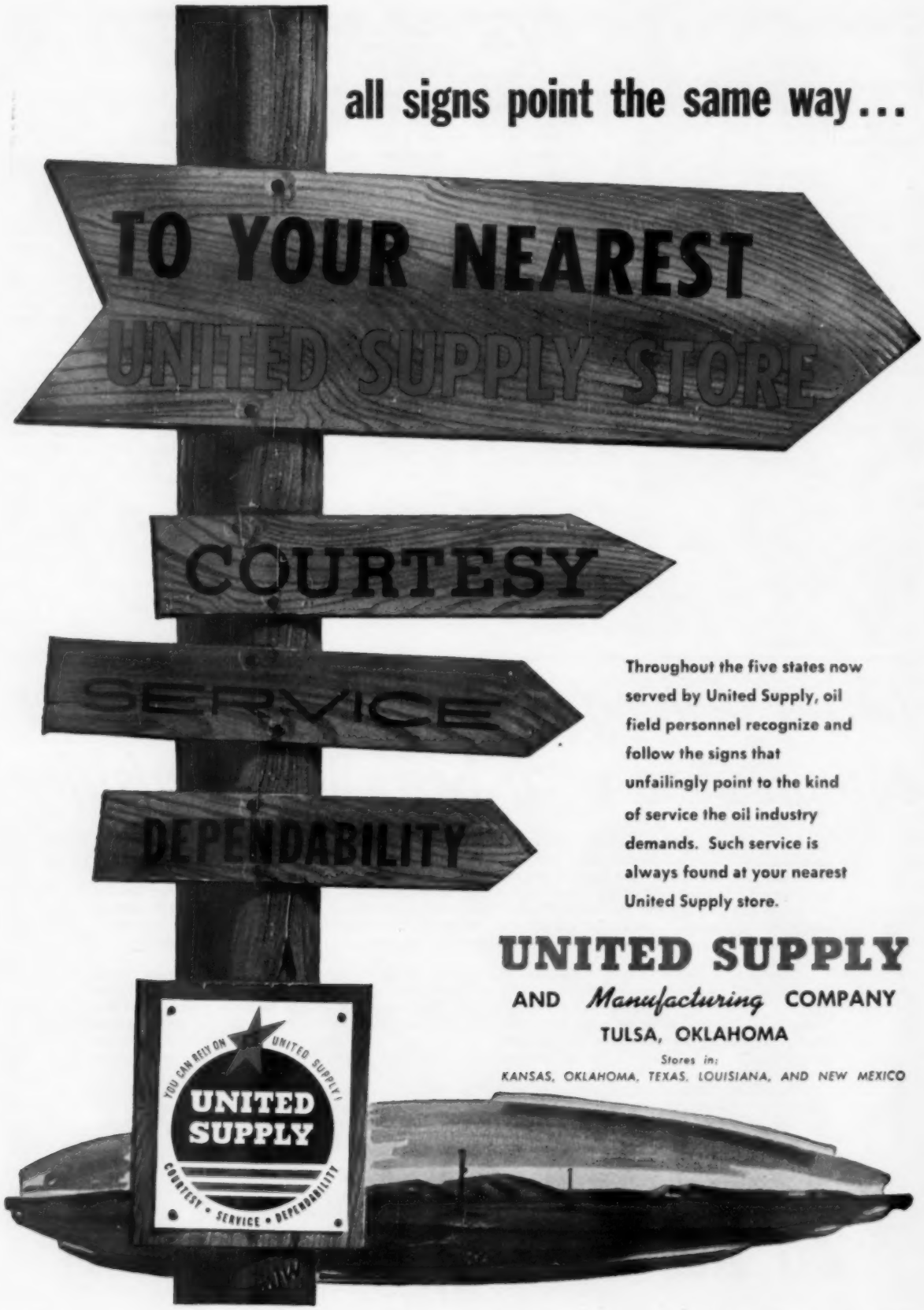

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48.6°, TP 4,200 psi., perforations 16,898-16,909 ft. TD 16,960 ft. (New pay and extension Four Isle field.)

Natural Gas & Oil Co. 1 State Lease 3141, 14-23s-16e. IP 160 BOPD, positive choke, 38°, GOR 518 cu. ft. per bbl. TP 1,300 psi., perforations 8,996-9,005 ft. TD 12,438 ft. (New field—6½ miles southeast of Dog Like field.)

Vermilion Parish: Superior Oil Co. 1 State Lease 3052, Township 15s-1w, in White Lake (6 mi'es southeast of West White Lake field) IP 296 BOPD, 5/32-in., 41.8°, GOR 1,175 cu. ft. per barrel, TP 2,017 psi., perfs 12,570-76 ft. TD 14,567 ft. (New field.)

Superior Oil Co. 2 State Lease 3,050, Township 15s-1w, in White Lake (6 miles southeast of West White Lake field). IP 145 BOPD and 5,323 M.c.f. daily, ¼-in., 44.1°, TP 4,275 psi., perforations 12,757-67 ft. TD 12,883 ft. (Second well and new pay in newly discovered field.)

O'Meara Brothers 2 Conner et al, 34-11s-1w. IP 150 BOPD, ⅛-in., 32.1°, TP 1,450 psi., perforations 8,612-22 ft. TD 8,687 ft. (New pay in Gueydan field.)

Pan American Petroleum Co. 4 Watkins, 13-13s-1w. IP 38 BOPD and 2,950 M.c.f. daily, 11/64-in., 55.1°, TP 3,075 psi., perforations 11,034-40 ft. TD 11,202 ft. (New pay in South Kaplan field.)

St. Mary Parish: Gulf Oil Corp. 1 State Lease 2963, Township 15s-11e, in Six Mile Lake (no section). IP 3,498 M.c.f. daily and 55 BOPD, ⅛-in., 48.1°, TP 3,800 psi., perforations 11,370-78 ft. TD 13,917 ft. (New field.)

LOUISIANA OFFSHORE

Cameron Parish: Magnolia Petroleum Co. 1-A OCS-089 (State Lease 1202), Block 64, East Cameron area, Gulf of Mexico. IP 16,000 M.c.f. daily calculated open flow, gas, perforations 10,294-10,306 ft., and (dual completion) 9,000 M.c.f. daily, calculated open flow, gas, perforations 9,804-16 ft. TD 12,916 ft. (New pay in East Cameron Block 64 field.)

Plaquemines Parish: Kerr-McGee Oil Industries, Inc., 1-C State Lease 1273, Block 53, Main Pass area, Gulf of Mexico. IP 4,851 M.c.f. daily, ¼-in., dry gas, TP 3,300 psi., perforations 9,683-95 ft. TD 11,000 ft. (New field.)

Vermilion Parish: Union Oil Co. of California 1-A OCS-0560, Block 67, Vermilion area, Gulf of Mexico. IP 3,900 M.c.f. daily, ¼-in., dry gas, TP 2,825 psi., perforations 7,356-64 ft. TD 9,854 ft. (New reservoir and extension in Vermilion Block 66-67 field.)

WEST CENTRAL TEXAS

W. W. West 1 Newell, 4-12-T&P, 10 miles west Albany. IPP 25 BOPD, 37°-gravity, Fliippen sand 1,523-29 ft. TD 1,611 ft.

Wilson Exploration Co. 1 Simpson, Sec. 18, BAL Sur., 2½ miles southeast Albany, new pay discovery. IP 124 BOPD, 11/64-in., 41°-gravity, GOR 510 top pay 4,262 ft. TD 4,650 ft.

Stephens County: Maxwell Drilling Co. 1 L. M. Adams, 32-7-T&P, 7 miles southwest Wayland. Recompletion. IP 230 BOPD, 41°-gravity, GOR 350, Mississippian 4,065 ft. TD 4,083 ft.

Ryan Consolidated Petroleum Corp. 2-A Smith, Y. M. Edwards Sur., A-1886, 2 miles south Eliasville. IP 384 BOPD, 1/8-in., 44°-gravity, GOR 300, TP 575 psi., Mississippian 4,403 ft. TD 4,412 ft.

Throckmorton County: Cities Service Oil Co. 1-210 Swenson, Sec. 210, BBB&C Sur., 9 miles northwest Throckmorton. Recompletion. IP 105 BOPD, 18/64-in., 37°-gravity, GOR 205, Strawn sand 4,040-50 ft. TD 5,511 ft., PB 4,175 ft.

Schulz & Brannon Drilling Co. 2 Cribbs, Sec. 3014, TE&L Sur. 934, 6 miles northwest Elbert. IPP 142 BOPD, 41°-gravity, GOR 400, pay 3,671-77 ft. TD 3,701 ft.

Woodson Oil Co. 2-B Nichols, Sec. 227, BBB&C Sur., 3 miles southwest Throckmorton. IP 112 BO in 18 hours, 12/64-in., 41°-gravity, GOR 690, pay 4,524-29 ft. TD 5,150 ft.

TEXAS GULF COAST

Calhoun County: Superior Oil Co 1 Maude B. Traylor, Phillips Dimmit Sur., A-11 (6 miles northwest of Olivia). IP 205.5 BCPD and 3,820 M.c.f. daily, 3/16-in., 51.2°, TP 5,125 psi., perforations 10,508-20 ft. (Frio). TD 11,322 ft. (New pay in North Maude B. Traylor field—formerly Point Comfort field.)

Jackson County: Midhurst Oil Corp. and Ogden & White 1 Mauritz Unit 1 Jesse White Sur., A-82 (6 miles southeast of Edna). IP 184 BOPD, ⅛-in., 40.6°, GOR 470 cu. ft. per bbl., TP 1,235 psi., perforations 7,209-15 ft. (Frio). TD 7,515 ft. (New pay in Hornbuckle field.)

Kleberg County: Arkansas Fuel Oil Corp. 1-C Kaufer, Kochs 1st Subd., Riviera Lands, Gabriel Trevino Sur., A-232 (3 miles southeast of Riviera). IP 9,000 Mc.f., open-flow potential, GLR 74.4 M.c.f. per bbl., 53.7°, shut-in tubing pressure 3,285 psi., perforations 8,618-28 ft. (Frio). TD 10,008 ft. (New pay in South May field.)

Matagorda County: Southern Minerals Corp. and Colvin & Waters 1 LeTulle, Ralph Wright Sur., A-407 (5 miles south of Palacious). IP 180,000 M.c.f. daily, absolute open-flow potential, dry, gas, shut-

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in pressure 1,688 psi., perforations 4,022-34 ft. TD 5,965 ft. (New field—Oyster Lake.)

Refugio County: Hoxsey Oil Co. 1 Langraf Brothers, Pierce Rollins Sur., A-358 (2 miles northeast of Tivoli). IP 76 BOPD, 7/64-in., 50°, GOR 1,550 cu. ft. per bbl., TP 800 psi., perforations 5,551-54 ft. (Frio). TD 5,656 ft. (New field.)

San Patricio County: Hawn Brothers and Logue & Patterson 1 Catherine Church Carmody et al, Section 22, Third Taft Farm Lots (5 miles northeast of Taft). IP 3,200 M.c.f. daily, open-flow potential, GLR 40 M.c.f. per bbl., 68.2°, shut-in tubing pressure 2,290 psi., perforations 6,253-58 ft. (Frio). TD 7,521 ft. (New pay and extension East Taft area.)

Wharton County: Anderson & Cocke 1 Vitera, Block 3, H. Mills Sur., A-270 (3 miles north of Louise). Shut-in gas well, no gage, perforations 4,562-66 ft. TD 5,575 ft. (New field.)

SOUTHWEST TEXAS

Atascosa County: Armstrong & Horn 1 Harding, Galba Fugua Sur., A-271. IP 76.57 BOPD, ⅛-in., 39°, GOR 480 cu. ft. per bbl., TP 300 psi., perforations 5,074-90 ft. (Navarro). TD 5,111 ft. (New reservoir in East Galba area.)

Bastrop County: C. J. Dick and Walter Badgett 1 Pearson, James Doyle Sur. (4 miles north of Lytton Springs). IP 153 BOPD, ⅛-in., 39°, GOR 90 cu. ft. per bbl., TP 130 psi., perforations 1,888-92 ft. (Buda). TD 2,096 ft. (New field.)

Dimmit County: Pronto Drilling Co. 1 W. A. Morriss, Jr., Block 37, Cross "S" Ranch Subd., Section 177-A, Narcisco Aguirre Grant, A-3. IP 161 BOPD, 3/16-in., 31°, GOR 900 cu. ft. per bbl., TP 210 psi., perforations 4,431-37 ft. (San Miguel). TD 4,454 ft. (New pay in Elaine field.)

Pronto Drilling Co. 1 Clark et al, Trinidad Sanches Sur., A-665. IP 128 BOPD, ⅛-in., 39.4°, GOR 600 cu. ft., GOR 600 cu. ft. per bbl., 7P 640 psi., perforations 2,817-23 ft. (Navarro). TD 3,038 ft. (New reservoir in Winter Garden area.)

W. J. Steeger et al 1 Armstrong, Section 12, Block 1, I&GN Sur., A-161, IPP 65.03 BOPD (net), 37°, 55 per cent water, perforations 4,205-11 ft. (Olmos). TD 4,502 ft. (New field.)

Pronto Drilling Co. 1 Paul Little, Lot 4, Section 177-A, Cross "S" Ranch Subd., Narciso Aguirre Grant, A-3. IP 165 BOPD, 3/16-in., 32°, GOR 680 cu. ft. per bbl., TP 480 psi., perforations 4,421-39 ft. (San Miguel FB-3 sand). TD 4,447 ft. (New pay in North Elaine field.)

Dimmit County: E. C. McRorey and Pronto Drilling Co. 1-A Verner, Trinidad Sanchez Sur., A-665. IP 82 BOPD, 3/16-in., 39.6°, GOR 690 cu. ft. per bbl., TP 420 psi., perforations 2,659-69 ft. (Navarro-Olmos 4-A sand). TD 2,790 ft. (New pay in East Wintergarden field.)

Frio County: H. B. Kaulbach 1 McDonald, Section 173, Camilla Cuples Heirs Sur., A-267. IP 110 BOPD, 5/32-in., 37°, GOR 200 cu. ft. per bbl., TP 285 psi., open-hole 3,597-3,614 ft. (Navarro-Olmos). TD 3,614 ft. (New field—12 miles northeast of Pearsall.)

Gonzales County: Mrs. James R. Dougherty 2 Patterson Estate, Wade Horton Sur. (3 miles northwest of Smiley). IPP 48.37 BOPD, 19.5°, perforations 1,387-92 ft. (Carrizo). TD 1,397 ft. (New field.)

Jim Hogg County: Joseph S. Morris et al 1 Mestena, Section 40, Fowler & Rankin Subd., El Sordo Grant, A-326 (12 miles southwest of Hebronville). IP 977 M.c.f. daily, ¼-in., TP 730 psi., perforations 6,762-74 ft. (Jackson). TD 4,200 ft. (New field—2 miles east of San Pablo field.)

Jim Wells County: Tidewater Oil Co. 14-SH Shaeffer Ranch, John Hannon Sur., A-202 (20 miles northwest of Alice). Shut-in gas well, no gage, perforations 2,374-80 ft. TD 5,200 ft. (New field.)

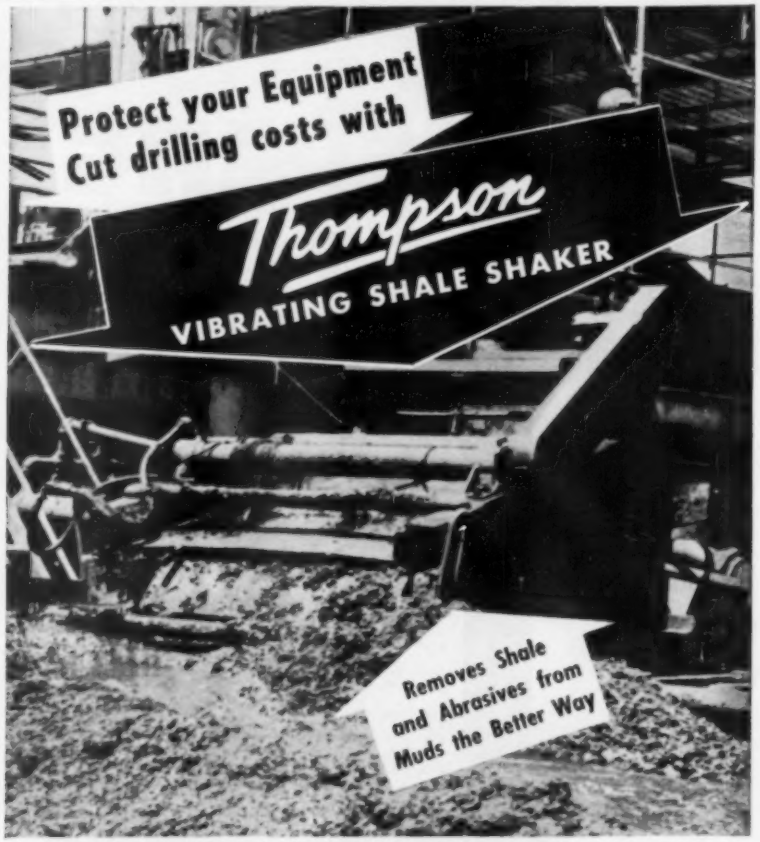
McMullen Couny: Kirkwood & Morgan, Inc., 1 Hagist Ranch, Section 3, BBB&C Sur., A-145 (11 miles north of Freer). IP 500 M.c.f. daily, open flow, dry gas, shut-in tubing pressure 317 psi., perforations 1,198-1,205 ft. (Jackson). TD 1,216 ft. (New pay in Hagist Ranch field.)

Kirkwood & Morgan, Inc., 2 Hagist Ranch, Section 3, BBB&C Sur., A-145 (11 miles north of Freer). IP 1,400 M.c.f. daily, open flow, dry gas, shut-in tubing pressure 385 psi., perforations 925-31 ft. TD 1,233 ft. (New pay in Hagist Ranch field.)

McMullen County: Peet Oil Co. 6 Ezzell, Section 56, Hays Ezzell Subd., S. M. Hodges Sur., A-773 (16 miles southwest of Simmons City). IP 1,950 M.c.f. daily, open-flow potential, GLR 108 M.c.f. per bbl., 57.6°, shut-in hubing pressure 1,936 psi., perforations 5,063½-67½ ft. (Qpeen City). TD 5,025 psi. (New field.)

Armstrong & Horn and Peet Oil Co. 1 Cousins, Section 100, G. W. Tindol Sur., A-1186. IP 4,900 M.c.f. daily, open-flow potential, GLR 31,769 cu. ft. per bbl., 63.5°, shut-in tubing pressure 2,503 psi., perforations 7,272-84 ft. (Wilcox-Slick). TD 7,940 ft. (New reservoir and extension for East Loma Alto area.)

Texas Seaboard Oil Co. 1-B Wheeler, Section 33, Two-Rivers Ranch Subd., Neill McLain Sur., A-553, 2½ miles southwest of Calliham. IP 3,650 M.c.f. daily, shut-in tubing pressure 469 psi., perforations 939-43 ft. (upper Government Wells sand). TD 1,515 ft. (New field—Dragon Creek.)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Mast poles, draw works, and wheels are unitized, with draw works built into the mast poles. The complete rig with mud line and blocks connected is raised, lowered, and moved without assembly or disassembly. Compact design assures top roadability plus ample working area at rotary table.

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ELECTRIC PLANT NEWS

Onan ELECTRIC PLANTS

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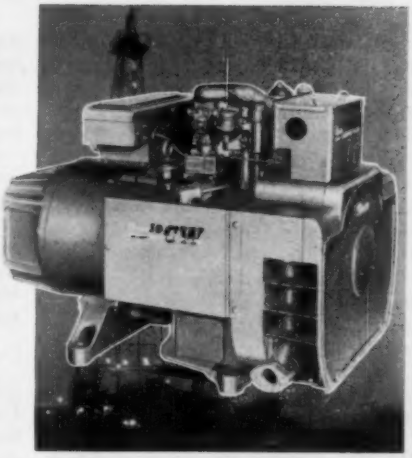
In exploration, drilling, pipeline construction and operation, the Onan "CW" does more jobs—better. Weighs hundreds of pounds less than water-cooled units of similar capacity but outlasts so-called "heavy duty" electric plants. Powered by smooth-running, two-cylinder opposed, Onan gasoline engine. Equipped with exclusive Onan Vacu-Flo cooling for enclosed installations. All-climate Onan generator, direct-connected. Skid mounting and 2-wheel weatherproof trailer available.



Onan CW series electric plants are available in 7½ or 10KW, A.C. Choice of all standard voltages. Other Onan Electric Plants from 500 to 75,000 watts.

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ELECTRIC PLANTS • AIR-COOLED ENGINES • GENERATORS • KAB KOOLER

Art Brown has worked in much of the oil world.

Geologist Heads Richmond

A. B. (ART) BROWN, who a few months ago took over the presidency of Richmond Exploration Co. in Venezuela, proves that environment can have a lot to do with shaping a man's career.

Born and reared in Bakersfield, Calif., in the heart of the San Joaquin Valley oil country, Brown became an oil man early, working at odd jobs in the fields during summer vacations from school.

When he entered the University of California in 1923, it was only natural for him to major in geology. Graduating in 1927, he turned off the main line for several years, working as a surveyor and mining engineer in Goldfield, Nev.

But in 1930 he was back in the oil business to stay, joining up as a geologist in southern California with Standard Oil Co. of California, parent company of Richmond Exploration.

His 27 years with the company have since taken him to Saudi Arabia, Sumatra, Java, Peru, most of the oil states in this country, and finally to Caracas, Venezuela, where he took over last May as head of Socal's operations there.

His job . . . The company Brown now heads was incorporated in 1944 as a wholly owned subsidiary of Socal. It has its own refinery and more than 60,000 bbl. daily production of heavy crude from Boscan field on the west side of Lake Maracaibo.

Richmond charges about 10,000 bbl. daily to the refinery and, with the addition of special blending components, turns out a like amount of asphalt. The plant, which went on stream in June of 1956, is located at Bajo Grande, just south of the city of Maracaibo.

Richmond also has a shipping terminal at Bajo Grande. A marine line connects the plant with a deep-water platform which can service ocean-going tankers. Richmond moves crude from Boscan field to the plant through its own 25-mile, 18-in. pipeline.

With Brown in Venezuela is his wife, Ruth, who has been with him on almost all of his world travels. Son Thomas, born the first year Brown went to Saudi Arabia, now lives in his dad's home town of Bakersfield.

When he isn't busy finding and producing oil, Brown relaxes with his cameras and darkroom. An accomplished amateur photographer, he's as ready to snap a shutter as he is to pack up his bag for the next stop on his typical oilman's career of world traveling.

William Lee Boyer, general manager for **Richard S. Rheem,** Bakersfield, Calif., oil operator, for the past 5 years, has been elected vice president of Bandini Petroleum Co. **Edward A. Gribi,** who joined Bandini several months ago, has been named supervisor of operations for Bandini Petroleum Co., Ltd., a Canadian corporation currently being organized. The Canadian firm will conduct operations on Bandini's Guatemala and British Honduras exploration rights and any future foreign interests.

Personals

Robert E. McWilliams, Humble Oil & Refining Co. engineer, has been transferred to Conroe, Tex., from Houston.

S. R. Knapp has been transferred by Falcon Seaboard Drilling Co. to Ardmore, Okla., from Lindsay, Okla.

Elmer L. Herbaly has left Gulf Oil Corp., where he was zone geologist in Oklahoma City, to join Alex W. McCoy Associates in Calgary as geologist.

W. A. Vaughn, superintendent at Cosden Petroleum Corp.'s Hawley refinery near Abilene, Tex., has been transferred to Big Spring, Tex., as process superintendent at the refinery there. **O. O. Craig,** styrene foreman at Hawley, moves up to superintendent.

W. C. Osborne has been named division geologist in Midland, Tex., for American Trading & Production Corp. He will be in charge of the exploration department and all geological and geophysical operations. Osborne was formerly district engineer with Union Oil & Gas Corp. of Louisiana.

M. W. RAMSEY

M. Wendell Ramsey, coordinator of products pipelines for Gulf Oil Corp. since 1955, has been appointed pipeline coordinator for Gulf's transportation department. He will supervise planning, programing, and coordination of pipeline activities. Ramsey succeeds **William J. Wilkins,** recently named president of Laurel Pipe Line Co. (OGJ, Oct. 7, p. 263). Ramsey has been with Gulf since 1950. He was assistant general manager of pipeline operations in the U. S. and Canada before being named coordinator of products pipelines.

Herbert F. Lindsay has been named manager of Tidewater Oil Co.'s new electronics computer department. Lindsay headed a special study group appointed last year to develop a company-wide program for operations research and electronic data processing. **Dr. John W. Bishop,** research chemist in the company's eastern division research and development department, has been assigned to the new department as senior operations analyst. **Harold J. Maddock,** chief technologist at

(Continued on page 335)

Why should you pay

for top quality in "Commercial Grade" Roller Bearings . . . AND NOT GET IT?

It's *wasteful* to pay for quality you don't need. It's *negligent* to pay for quality you don't get.

From the simplest steel-cage type to the finest segmented-retainer type, Rollway "commercial grade" Tru-Rol Roller Bearings incorporate as closely as possible design and construction principles found normally in a Rollway maximum-type precision bearing.

Take the segmented-type Tru-Rol for example. Each deep-section separator segment is formed to fit the curvature of the roller. Each roller has a separator segment to keep it in accurate alignment. And each roller is crowned to distribute load evenly along the full length of the roller.

That's a lot different from small-diameter, unground spacers staggered at unequal intervals, resulting in rollers rubbing in opposed-motion, and non-uniform roller distribution that can set up out-of-balance vibration and "pulse".

Let a near-by Rollway Service Engineer consult with you on your bearing problems. No charge. No obligation. Just write us. Rollway Bearing Co., Inc., Syracuse, N. Y., *manufacturers of a complete line of radial and thrust cylindrical roller bearings.*

Cutaway view of Rollway Tru-Rol® segmented-retainer roller bearing . . one of three distinct types of Tru-Rol bearings available.

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Retainer Operation

☐ Is the retainer roller-supported, to reduce sliding friction?

Retainer Construction

☐ Is the retainer strong enough to withstand shock loads and sudden reversals?

(A Rollway segmented-type steel retainer, such as that illustrated, is the strongest, most durable available in commercial grade bearings.)

Roller Spacing

☐ Are all rollers equally separated, or do some rub against each other in opposed-motion friction?

☐ Are rollers distributed evenly to prevent "pulse" and vibration?

Roller Construction

☐ Are the rollers crowned for optimum load distribution?

For Top Quality in Every Detail Buy Tru-Rol and Be Sure!

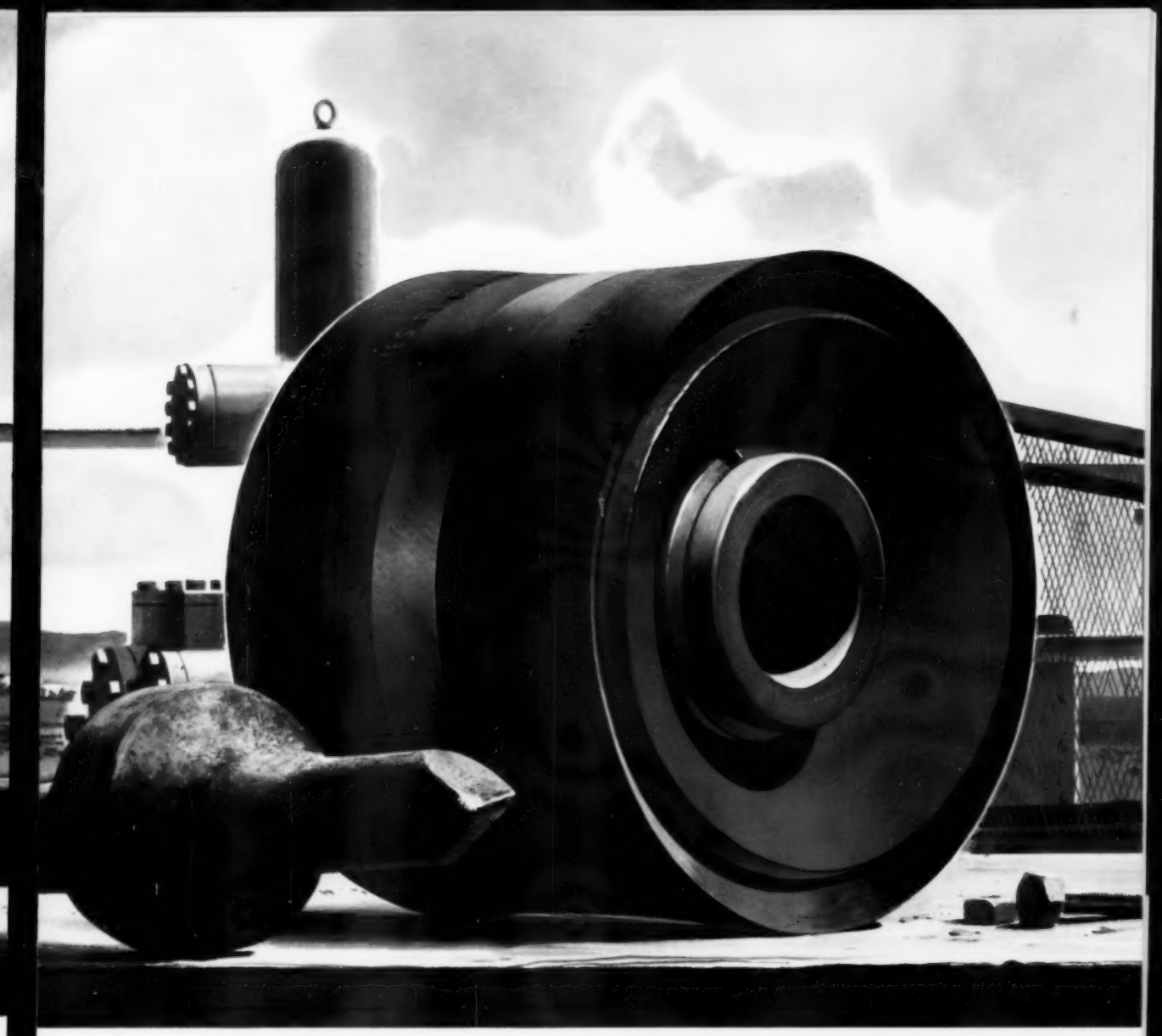
There's a lot more difference in these **MISSION PISTONS** than just ten years!

Although these two Mission Pistons look a lot alike, the 1957 model at the left will give much better service than the 1947 model at the right.

With the 1957 model, you can take advantage of far higher pump pressures than you could when using any other pistons — including Mission Pistons of ten years ago.

Or, if you don't require high pressures, you can get far longer service life than before.

Why? There are many good reasons! In the past ten years for example, *27 improvements*



have been incorporated into Mission Pistons.

Most of these improvements, such as advances in piston rubber compounds, can't be seen, but they mean that today's Mission Pistons are giving excellent service under jet drilling conditions that would have been considered impossible only ten years ago.

In addition to the changes actually made, Mission Engineers have conducted 371 *test pump laboratory and field tests on piston rubbers alone in just the last three years.* That's an average of over 120 tests per year.

This kind of research means lower costs, less down time, better slush pump performance and faster drilling for you. It is an important reason why more Mission Pistons continue to be used than all other makes combined. You can get Mission Pistons and Mission Piston Rubbers through supply stores everywhere.

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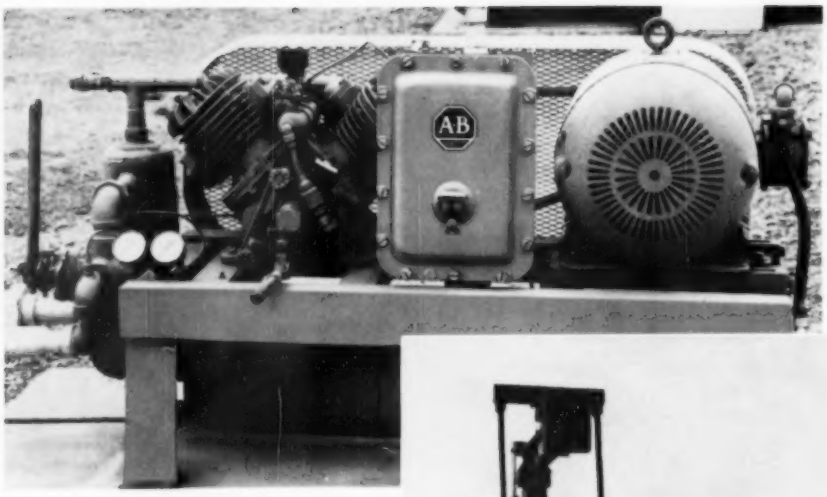


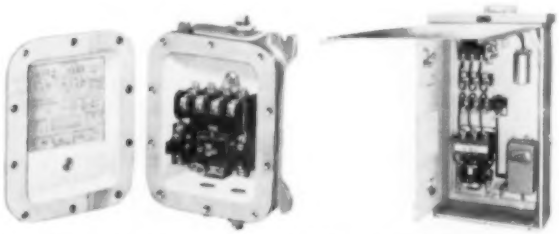
The Sign of
QUALITY
MOTOR CONTROL

Bulletin 709 explosion-proof across-the-line motor starter with push buttons in cover. On LPG loading pump in Midland County, Texas, tank truck terminal.

Bulletin 1242 motor starter on pumper in Carter County, Oklahoma. Equipped with overload relays, fused disconnect, under-voltage relay, lightning arrestor, time switch, and Hand-Off-Auto. selector.

Install A-B solenoid motor controls . . . and forget them!

It's actually true . . . you can install Allen-Bradley solenoid motor starters and forget them. For instance, the silver alloy, double break contacts never need to be cleaned, filed, or dressed. They are always in good operating condition. The starter has only ONE MOVING PART—the solenoid plunger. There are no pins, pivots, or bearings to corrode and stick. Hence, no maintenance.



Left—Bulletin 709 Size 1 solenoid starter in NEMA Type 7 explosion-proof enclosure with bolted cover removed to show wide, machined flange on cover and base. Type 7 starters available up to 50 hp, 220 v; 100 hp, 440-550 v. Not having to inspect starters with bolted enclosures regularly is a timesaving advantage.

Right—Bulletin 1242 Size 2 pumper control in a NEMA Type 3 enclosure, with cover lifted to show switch compartment, also open. Manual disconnect at top of enclosure. Type 3 starters available up to 50 hp, 220 v; 100 hp, 440-550 v.

Bulletin 709 starters are supplied in a large variety of enclosures, such as watertight and weatherproof, dust-tight, corrosion-proof, etc., to meet every operating condition.

The Bulletin 1242 oil pumper control is similarly trouble free. It is equipped with an Allen-Bradley Bulletin 709 starter, program time switch, lightning arrestor, fused disconnect switch, etc. The overload relays, being of the solderpot type, remain dependable and accurate, even after long periods of inactivity. The inner door of the switch compartment cannot be opened unless the disconnect lever is in the OFF position. Send for your copy of the A-B Handy Catalog.

ALLEN-BRADLEY

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis.
In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

(Continued from page 330)

Tidewater's Avon, Calif., refinery, will be operations analyst. Also assigned to the new department are **Justin B. Murrish,** electronic data processing analyst; and **Dr. Werner W. Leutert,** mathematician. Murrish assisted in planning the mechanism of the Sixth Army Reserve's data-processing functions before joining Tidewater. Leutert was head of computer groups at the Aberdeen Proving Ground in Maryland. Lindsay, manager of the new department, was head of the computer systems development office of Sacramento Air Material Area before joining Tidewater.

Robert M. Lowe, head of Sohio Petroleum Co.'s reservoir engineering section, will become northwest division engineer for the company January 1. **A. E. Hall,** head of the special-projects section, has been temporarily assigned as assistant to the chief engineer, but will succeed Lowe as head of the reservoir engineering in January.

F. B. NEPTUNE

F. B. Neptune, manager of Phillips Petroleum Co.'s products-pipeline division of the supply and transportation department, has been promoted to executive vice president and general manager of Phillips Pipe Line Co. He will also be manager of the parent company's new pipeline division. Neptune succeeds **M. O. Johnson,** who was recently appointed head of Phillips' computing department. **D. A. Roach,** chief engineer in Phillips engineering division of the supply and transportation department, has been elected vice president of Phillips Pipe Line. Roach and **W. H. Wallace,** manager of the crude-oil pipeline division, have been named assistant managers of the new pipeline division. Roach will be in charge of engineering; Wallace, in charge of operations.

J. M. Hillard has been named district superintendent for Richfield Oil Corp.'s Canadian division production department in Calgary. Hillard joined Richfield as a roustabout in 1940. He is a graduate of the University of California.

G. H. Zwiebel, Jr., has been named seismic party chief for Namco International in Tripoli, Libya. Namco is foreign operations affiliate of National Geophysical Co., Inc. Zwiebel was formerly with National in Houston.

Harry C. Hanna, petroleum engineer, has been transferred by Kerr-McGee Oil Industries, Inc., to Oklahoma City from Morgan City, La.

Carl M. Aikele, formerly process engineer with Pollak & Skan, Inc., in Denver, has joined Pontiac Refining Corp. as chemical engineer in Corpus Christi, Tex.

E. D. Anderson, district production engineer for Lone Star Gas Co. and Lone Star Producing Co. at Dallas, has been promoted to production superintendent at Dallas in charge of Lone Star Producing Co. personnel in the production department. **Jack Gourley,** also formerly a production engineer at Dallas, has been named assistant chief engineer.

Adam G. Donaldson has been appointed vice president and exploration manager of Calalta Petroleums, Ltd., and Phillips Oil Co. The two Canadian independent companies have been associated in many operations in western Canada. Donaldson, a graduate of the University of Alberta, was formerly senior mine manager for Lethbridge Collieries.

John C. Bolinger, Jr., assistant to the president of Mississippi River Fuel Corp. and vice president and director of its subsidiary operations, has been elected president and a director of East Tennessee Natural Gas Co., Knoxville, Tenn. He succeeds **Guy T. Henry,** who recently became president of Providence (R. I.) Gas Co. Henry will continue as a director of East Tennessee Natural.

Benjamin F. Baldwin, district exploration superintendent at Houston for Pan American Petroleum Corp., has been transferred to Lubbock, Tex., in the same capacity.

J. A. Vickers, president of Vickers Petroleum Co., Inc., has been elected by nine Kansas oil associations to receive an "Oil Man of the Year" award. Vickers was honored on the basis of his participation and leadership in oil industry groups. He will receive the award during Oil Progress Week in Wichita.

Dr. James C. Kirk, research supervisor in Continental Oil Co.'s petrochemicals research division, has been appointed director of research for Petroleum Chemicals, Inc. He will headquarter in Lake Charles, La. Petroleum Chemicals is jointly owned by Continental and Cities Service Oil Co. A graduate of Baylor University and Ohio State University, Kirk has been with Continental since 1949.

Personals

P. D. BAKER

Philip D. Baker, Carter Oil Co.'s chief petroleum engineer, has been appointed southern division production manager with headquarters in Shreveport. Baker succeeds **Howard Kauffmann, Jr.,** who has joined International Petroleum Co., Ltd., in Coral Gables, Fla. Baker's promotion has set off moves by seven other engineers. **George C. Hollinger,** assistant chief petroleum engineer, has moved up to replace Baker as chief petroleum engineer in Tulsa. **Joseph S. Bottler, Jr.,** central division engineer at Oklahoma City, will succeed Hollinger. Bottler will be replaced as division engineer by **John B. Campbell,** staff engineer at Oklahoma City. **John H. Adams,** district engineer in Seminole, Okla., has been transferred to Oklahoma City to replace Campbell. Also, **Joe T. Taylor,** senior engineer at Purcell, Okla., has moved to Seminole to succeed Adams. **D. C. Hurst,** senior engineer in charge of the petroleum engineering section in Tulsa, has been named Magnolia, Ark., district engineer, and **Horace Quattlebaum** will replace Hurst as head of the Tulsa petroleum engineering section.

Ward M. Clark, Midwest Oil Corp. petroleum engineer in Midland, Tex., has been promoted to district engineer and transferred to Calgary.

John H. Schaefer, Ethyl Corp.'s vice president in charge of manufacturing, has been named staff vice president, a new position. **Glenn O. Haynes** succeeds Schaefer in charge of manufacturing. He will also remain employe relations department director.

Earl Beavers, petroleum engineer in Fort Worth for Champlin Oil & Refining Co., has been transferred to Midland, Tex., as district engineer.

T. R. Beauchamp has been named superintendent of The Texas Co.'s Los Angeles Basin production district, Long Beach, Calif. Beauchamp succeeds **R. K. Jackson,** who has retired. **T. W. Fisher,** assistant superintendent of Texaco's San Joaquin Valley district, Bakersfield, Calif., since 1950, has been transferred to Santa Paula, Calif., to succeed Beauchamp as superintendent of the company's Ventura producing district. Beauchamp joined Texaco in 1923; Fisher in 1927.

Two Receive Texas Mid-Continent Honors

J. C. Donnell II, left, president of Ohio Oil Co., and Robert F. Windfohr, right, Fort Worth independent, are congratulated by Charles Alcorn, new president of Texas Mid-Continent Oil and Gas Association, after both received Distinguished Service Awards at the association's annual meeting in Fort Worth.

Keith Gott has joined Russell Maguire as assistant chief engineer.

Charles E. Thornton has been transferred by Reading & Bates Drilling Co. to Tulsa from Denver.

Carl Miles, president of Miami Operating Co., will also be president of Miami Petroleum Co., Inc., a newly organized exploration affiliate of Miami Operating. The new company plans to spend $10 million in exploration in the next 4 years. They will concentrate on West Central Texas, New Mexico, Utah, and Colorado. **Jack Stiver** has been named vice president of the new firm. He will continue as drilling and production superintendent of Miami Operating Co. **G. C. Roberts,** formerly with Progress Petroleum Corp., Abilene, Tex., has joined Miami Petroleum as exploration manager. **Calvin A. Mitchell,** manager of the land department of Miami Operating, will serve in the same capacity with the new company. Directors of Miami Petroleum are **James E. Goodman,** vice president of General Motors in charge of Fisher Body; **Harvey C. Fruehauf,** retired chairman of the board of Miami Operating Co. and retired president of Fruehauf Trailer Co.; **Harry J. Klingler,** retired president of Pontiac Motors and retired vice president of General Motors; and **John B. Rauen,** former owner of U. S. Spring & Bumper Co.

Jack L. Turner, engineering and geological consultant, has moved his offices to Tyler, Tex., from Abilene, Tex.

Bill J. Langford has left Shell Oil Co., where he was exploitation engineer in Farmington, N. M., to join Heritage Petroleum Corp. as reservoir engineer in Dallas.

Personals

Ed Reid has joined Murphy Corp. in Billings, Mont., as area geologist. He was formerly with Flank Oil Co.

Robert F. Fischer, chemical engineer, has been transferred by Gulf Oil Corp. to Cleves, Ohio, from Philadelphia.

Art L. Walker, Jr., has left the Oklahoma State Corporation Commission to open geological consulting offices in Oklahoma City.

Dr. John C. Calhoun, Jr., dean of engineering, has been elected vice president of Texas A. & M. College. Dr. Calhoun formerly was head of the department of petroleum engineering at the University of Oklahoma, and later at Pennsylvania State University.

Luis E. Arzola has been promoted by Commonwealth Oil Refining Co. from engineer to technical assistant to the president. Arzola has been assigned to construction problems of the company's new refinery near Ponce, Puerto Rico, since joining Commonwealth in 1955.

John Packie, manager of engineering coordination for Esso Research & Engineering Co., has been appointed coordinator of engineering services and research. **Luther Martin,** associate manager of engineering coordination, moves up to manager replacing Packie.

DEATHS

James O'Brien, 90, retired director of Southwestern Pennsylvania Pipe Lines, Oil City, Pa., died recently in St. Petersburg, Fla.

Richard S. Stewart, 47, vice president for production with Standard Oil Co. (Ohio), and his wife, Ruth, were killed in the crash of a company twin-engine plane October 6 near Uniontown, Pa. They were returning to Cleveland from White Sulphur Springs, W. Va., where Stewart had gone for a physical checkup required annually of Sohio executives. Stewart was named vice president for production 3 months ago. He joined Sohio in 1938 after serving several years with The Texas Co. He became operations manager for the manufacturing department refineries and plants in 1945, assistant to the president in 1949, and a vice president in 1954. In 1955, Stewart was president of Iricon Agency, Ltd., which represents nine American companies with oil interests in Iran.

G. Stewart Crane, chairman of the board of the plans committee of Cutler-Hammer, Inc., equipment manufacturers, and Milwaukee civic leader, died September 28 in Milwaukee after a heart attack. He was 69.

Gail A. Burns, 61, Tulsa district manager of Clark Brothers Co., oil equipment firm, died October 5 in Tulsa. Burns was a drilling contractor before joining Clark. He was transferred to Tulsa from Houston with Clark in 1948.

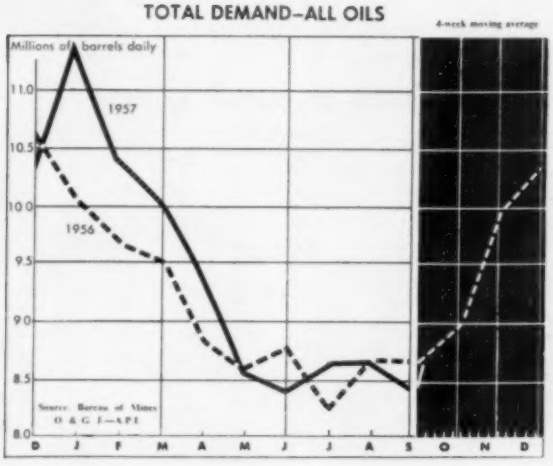
J. P. Wilkinson, 46, Midland, Tex., independent, was killed October 5 in an auto accident near Sterling City in West Texas. Wilkinson had operated in Midland for the past 9 years.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,803,800	DOWN	30,600	DOWN	199,787
Crude stocks	282,363,000	DOWN	802,000	UP	3,707,000
Completions	1,172	UP	25	UP	52
Refinery runs	7,779,000	DOWN	139,000	UP	82,000
Gasoline stocks	177,383,000	DOWN	47,000	UP	1,383,000
Kerosine stocks	35,775,000	DOWN	556,000	UP	2,532,000
Distillate stocks	171,291,000	UP	2,026,000	UP	19,486,000
Residual stocks	58,103,000	UP	387,000	UP	10,804,000
Four-product stocks	442,552,000	UP	1,810,000	UP	34,205,000
Total imports	1,656,300	UP	296,700	UP	168,100

TOTAL DEMAND—ALL OILS



Distillate Stocks Have Climbed 42,000,000 Bbl. in the Past 3 Years

REFINERS will have to hold a tight rein on both refinery runs and distillate yields for at least the first half of the heating season.

Distillate stocks in primary storage amounted to 171,291,000 bbl. on October 4 compared with 151,805,000 bbl. on October 5, 1956. Stocks at the end of September 1956 were 7,000,000 bbl. higher than in 1955, and in turn the 1955 stocks were 15,000,000 bbl. higher than in 1954.

These figures indicate that current stocks are at least 20,000,000 bbl. too high. Even if you make a liberal estimate of 10,000,000 bbl. for the distillate that has not moved to secondary storage this fall, stocks are 10,000,000 bbl. too high. Distillate production can be cut back by lower-than-normal runs, reduced yields, or both.

It will take a cut in runs of about 325,000 bbl. daily to reduce distillate production by 10,000,000 bbl. over the next 4 months. This assumes a normal yield pattern of about 25 per cent.

The reduction can be made through a shift in yields. When crude runs are averaging 8,000,000 bbl. daily, a reduction in distillate yield from 25 per cent to 24 per cent will cut distillate output 80,000 bbl. daily. This cut, if continued over the next 4 months, would account for almost 10,000,000 bbl. of distillate.

Actual refinery operations this fall probably will include a lower percentage yield of distillate fuels as well as restricted runs.

Refinery runs averaged almost 8,000,000 bbl. daily in September. The big gain in product stocks was definite proof that runs were too high. Primary inventories of the four major products increased 27,597,000 bbl. in the 4-week period ended September 27. A normal increase for September would be somewhere near 10,000,000 bbl. With stocks already high at the start of the month, projected product demand for the fourth quarter probably could have been met without any increase in major product stocks in September.

Since refiners did not cut runs in September enough to compensate for lower product demand, the adjustment will have to come in the fourth quarter. Product markets will be under less pressure if the cuts are made early in the quarter.

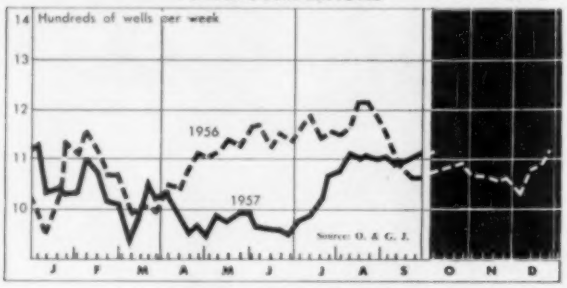
If the needed reduction in refinery runs comes in October, there is very little chance that crude stocks will be lowered during the month.

October allowables in states with allocated production and trends in other areas indicate October production of 6,750,000 bbl. daily. Crude imports will average about 990,000 bbl. daily, bringing the new-crude average to 7,740,000 bbl. daily.

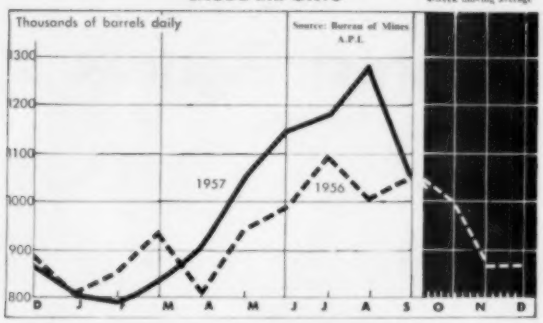
Crude exports, transfers, and losses will account for about 87,000 bbl. daily. If refinery runs are cut to 7,650,000 bbl. daily, crude use will be in balance with new supply. Crude stocks will be reduced by the amount refinery runs exceed 7,650,000 bbl. daily.

Cooler weather in some of the North Central states is helping to start the movement of light heating oils. Group 3 prices are firming a little, but market reports indicate that price increases have been limited to material that has been moving below the normal market.

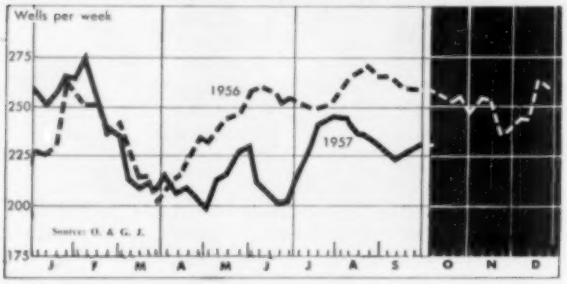
TOTAL COMPLETIONS



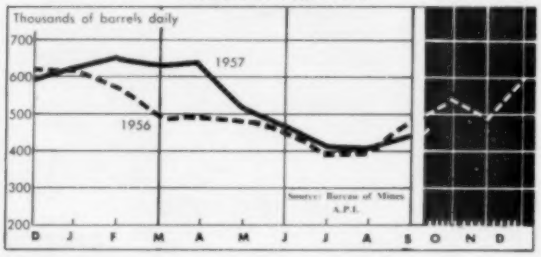
CRUDE IMPORTS



WILDCAT COMPLETIONS



PRODUCT IMPORTS

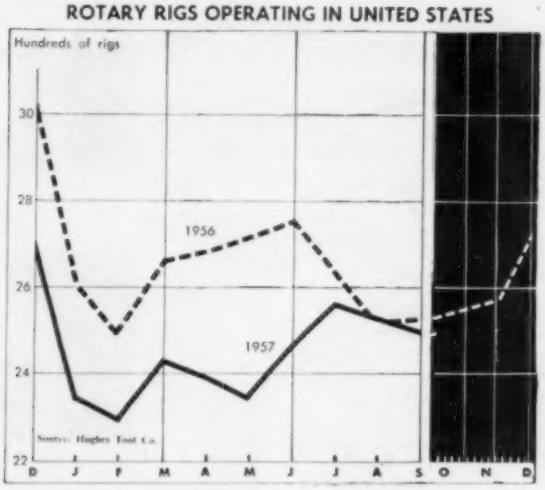


WEEKLY WELL COMPLETIONS . . . WEEK ENDED OCTOBER 5, 1957

	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1957	1956	Total	Crude	Cond.	Gas	Dry	1957	1956
Alabama	2	1	0	0	1	0	23,839	67	‡82	1	0	0	0	1	21	‡36
Arkansas	27	18	0	0	9	0	77,763	853	705	8	0	0	0	8	157	146
California	49	35	0	1	13	0	187,530	1,672	1,716	9	0	0	0	9	403	409
Colorado	11	2	0	2	7	0	56,371	640	921	5	0	0	1	4	422	490
Illinois	57	30	0	0	27	0	153,868	1,997	2,972	5	0	0	0	5	484	581
Indiana	12	2	0	0	10	0	17,909	492	527	4	0	0	0	4	97	108
Kansas	71	7	0	6	35	3	256,596	3,188	3,845	12	0	0	0	12	640	825
Kentucky	41	11	0	5	25	0	57,275	1,134	1,430	7	1	0	0	6	232	334
Louisiana	95	54	3	9	29	0	648,676	2,933	2,947	12	3	0	0	9	516	590
North	48	24	0	8	16	0	180,172	1,061	1,281	7	2	0	0	5	140	195
South	37	23	3	0	11	0	358,110	1,348	1,339	5	1	0	0	4	312	335
Offshore	10	7	0	1	2	0	110,394	524	327	0	0	0	0	0	64	60
Michigan	9	3	0	0	6	0	27,915	325	337	6	0	0	0	6	118	131
Mississippi	5	2	0	0	3	0	41,272	298	344	3	0	0	0	3	156	168
Montana	4	2	0	0	2	0	18,332	309	349	2	0	0	0	2	121	128
Nebraska	21	5	0	0	16	0	124,643	676	753	13	2	0	0	11	375	369
New Mexico	48	24	0	15	9	0	238,617	1,636	1,464	3	0	0	0	3	211	199
Northwest	26	7	0	15	4	0	123,435	673	637	3	0	0	0	3	81	68
Southeast	22	17	0	0	5	0	115,182	963	827	0	0	0	0	0	130	131
New York	9	4	0	0	0	5	9,250	353	.....	0	0	0	0	0	6	.....
North Dakota	13	9	0	1	3	0	85,410	212	201	5	1	0	1	3	96	61
Ohio	28	17	0	3	5	3	71,482	857	806	0	0	0	0	0	10	9
Oklahoma	130	71	1	7	48	3	458,079	4,798	6,461	13	2	0	1	10	559	686
Pennsylvania	31	13	0	5	3	10	65,890	517	†769	0	0	0	0	0	39	†20
Texas	459	262	12	26	157	2	1,981,849	16,736	17,014	93	11	4	1	77	4,002	4,340
District 1	31	19	0	0	12	0	74,667	963	*2,416	8	1	0	0	7	325	*829
District 2	10	1	1	3	5	0	65,214	582	*2,030	3	0	1	0	2	209	*671
District 3	41	22	3	1	15	0	251,965	1,325	.....	9	0	1	0	8	374	.....
District 4	27	10	4	1	12	0	157,534	1,090	.....	5	1	1	0	3	358	.....
East	28	12	0	0	16	0	151,000	1,022	892	9	0	0	0	9	295	317
District 7-B	89	43	1	5	40	0	298,247	2,251	.....	23	2	0	1	20	769	.....
West	146	113	1	1	29	2	693,121	4,755	4,558	20	6	0	0	14	678	717
District 9	54	29	0	1	24	0	149,750	3,638	*6,104	13	1	0	0	12	910	*1,714
District 10	33	13	2	14	4	0	140,351	1,110	1,014	3	0	1	0	2	84	92
Utah	4	3	0	0	1	0	20,303	164	98	1	0	0	0	1	83	58
West Virginia	19	6	0	11	2	0	53,850	520	517	1	0	0	0	1	24	18
Wyoming	25	5	0	3	16	1	89,010	647	660	10	1	0	0	9	224	193
Miscellaneous (S.D.)	2	0	0	0	2	0	4,130	111	70	2	0	0	0	2	94	63
Total U. S.	1,172	606	16	94	429	27	4,769,859	41,135	44,988	215	21	4	4	186	9,090	9,962
Total prev. week	1,147	611	26	79	409	22	4,816,105	.....	.....	228	31	4	6	187	.....	.....
Cum. 1957	41,135	21,323	416	2,965	15,567	864	170,131,826	.....	.....	9,090	931	79	312	7,768	.....	.....
Western Canada	87	57	0	7	21	2	400,122	2,369	2,411	24	8	0	3	13	666	.....

*Districts: 2 & 3, 1 & 4, 9 & 7-B, formerly combined. †Incl. New York. ‡Incl. Florida and Georgia.

ROTARY RIGS OPERATING IN UNITED STATES



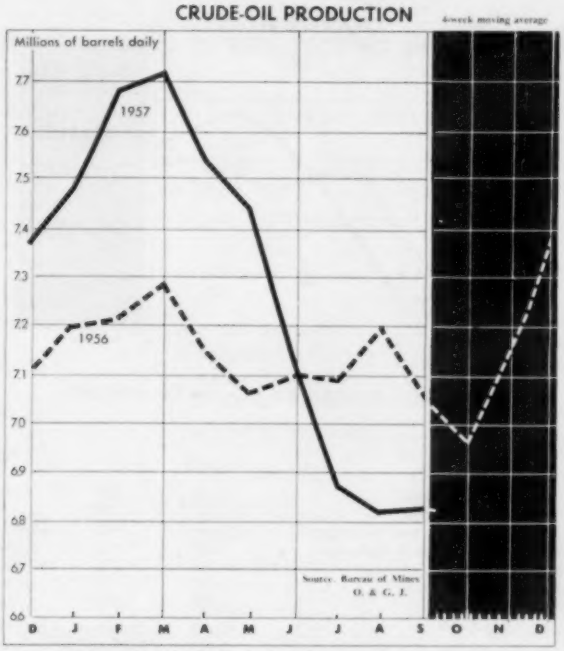
ACTIVE ROTARY RIGS*

Area—	10-7-57	9-30-57	9-23-57	10-8-56
Alabama	4	2	4	8
Arkansas	23	27	26	18
Arizona	1	1	1	....
California	95	98	97	113
Colorado	56	63	69	65
Florida	1	1	1	5
Georgia	....	....	....	....
Idaho	....	....	....	....
Illinois	61	63	71	81
Indiana	11	6	8	8
Iowa	2	2	2	1
Kansas	161	151	148	179
Kentucky	10	8	10	12
Louisiana	436	427	450	425
North	56	61	63	68
South	291	276	292	357
Offshore	89	90	95	(†)
Maryland	1	1	1	....
Michigan	11	8	11	16
Missouri	....	....	....	1
Montana	34	33	33	45
Mississippi	41	42	40	28
Nebraska	36	36	34	28
Nevada	....	....	....	1
New Mexico	141	148	155	119
New York	....	....	....	....
North Dakota	36	40	40	25
Ohio	....	....	....	1
Oklahoma	257	253	266	270
Oregon	1	1	1	....
Pennsylvania	11	14	13	8
South Dakota	1	2	....	....
Texas	898	852	887	985
Gulf Coast	196	181	195	249
Offshore	4	2	3	(‡)
West	359	349	357	381
North	280	271	279	285
East	59	49	53	70
Tennessee	1	1	1	....
Utah	71	68	64	29
Washington	1	1	1	1
West Virginia	3	2	4	2
Wyoming	83	82	73	82
Virginia	....	....	1	....
Total United States	2,488	2,433	2,512	2,556
Western Canada	190	194	201	248
Eastern Canada	3	3	3	....
Grand total	2,681	2,630	2,716	2,804

*Hughes Tool Co. †Included with South Louisiana. ‡Included with Texas Gulf Coast.

CRUDE-OIL PRODUCTION

4-week moving average

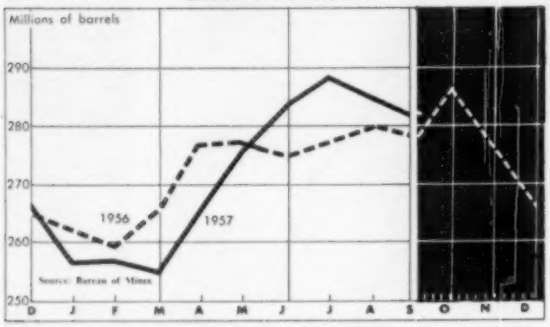


DAILY AVERAGE PRODUCTION FOR WEEK

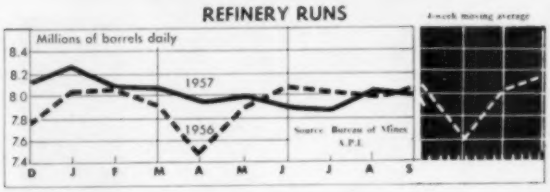
	October 5, 1957			Sept. 28
	Crude oil	Lease condensate	Total	total
Alabama	16,275	....	16,275	16,200
Arkansas *	81,380	270	81,650	81,600
California	928,000	.....	928,000	928,700
Colorado	147,400	.....	147,400	148,950
Eastern	53,600	.....	53,600	53,200
Florida	1,225	.....	1,225	1,250
Illinois	227,900	.....	227,900	226,600
Indiana	34,500	.....	34,500	33,500
Kansas	†337,200	.....	†337,200	†338,600
Kentucky	46,000	.....	46,000	46,800
Louisiana	724,225	77,400	801,625	780,300
North	119,950	2,400	122,350	122,300
South	604,275	75,000	679,275	658,000
Michigan	26,000	.....	26,000	26,200
Mississippi	99,900	4,500	104,400	103,550
Montana	74,650	.....	74,650	74,700
Nebraska	56,200	.....	56,200	54,800
Nevada	150	.....	150	100
New Mexico	248,950	4,300	253,250	253,400
North Dakota	32,900	.....	32,900	34,650
Oklahoma	†572,400	.....	†572,400	†553,600
Texas	2,648,575	55,100	2,703,675	2,774,400
Dist. 1	48,650	500	49,150	50,000
Dist. 2	120,100	8,800	128,900	134,100
Dist. 3	382,150	26,800	408,950	419,800
Dist. 4	201,275	6,300	207,575	213,100
Dist. 5	33,500	300	33,800	35,775
Dist. 6	113,350	5,900	119,250	126,400
East Texas Field	161,650	.....	161,650	170,500
Dist. 7-B	147,275	75	147,350	153,050
Dist. 7-C	139,700	3,875	143,575	145,675
Dist. 8	994,850	1,400	996,250	1,013,400
Dist. 9	201,925	600	202,525	205,100
Dist. 10	104,150	550	104,700	107,500
Utah	11,200	.....	11,200	11,550
Wyoming	293,400	.....	293,400	291,550
Others	‡200	.....	‡200	‡200
Total U. S.	6,662,230	141,570	6,803,800	6,834,400
Change from previous week, down			30,600	
Canada	†438,600	.....	†438,600	†479,600
Total U. S. production—January 1-October 5			§2,019,606,825 bbl.	
Same period last year (clude plus cond.)			*1,993,118,888 bbl.	

*Includes 34,158,180 bbl. condensate. †Week ended previous Monday. ‡South Dakota. §Revised.

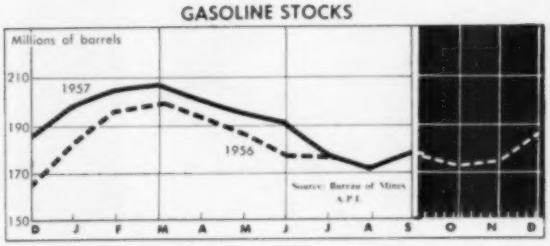
CRUDE-OIL STOCKS



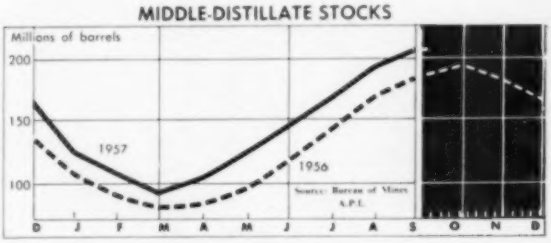
REFINERY RUNS



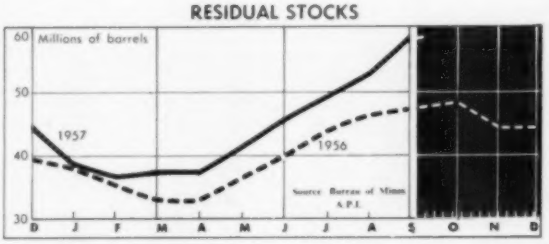
GASOLINE STOCKS



MIDDLE-DISTILLATE STOCKS



RESIDUAL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	9-28-57	9-21-57	9-29-56
Pennsylvania Grade	3,146	3,213	2,549
Other Appalachian	1,812	1,759	2,552
Illinois, Indiana, and Michigan	11,676	11,663	11,352
Nebraska and North Dakota	3,046	2,835	2,204
Kansas	10,399	10,572	10,206
Oklahoma	21,771	22,072	25,840
Arkansas	2,530	2,673	2,824
Louisiana	19,428	19,462	17,532
North	3,243	3,246	2,651
South	16,185	16,216	14,971
Mississippi, Ala., and Fla.	3,030	2,894	3,030
New Mexico	10,079	10,304	8,595
Texas	126,462	126,995	125,115
East Texas	9,878	9,980	8,980
West Texas	60,068	60,508	60,914
Texas Gulf	24,542	24,376	23,644
Other Texas	31,974	32,131	31,577
Wyoming	15,803	15,861	17,095
Other Rocky Mountain	6,125	6,045	6,188
California	31,627	31,042	27,276
Foreign	‡15,429	15,775	16,298
Total	282,363	283,165	278,656

*Bureau of Mines. ‡Includes 5,091,000 bbl. in California.

A.P.I. REFINERY REPORT, OCTOBER 4, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, October 1956 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,089	496.3	3.7	314.4	198.4	42,865	14,459	64,806	13,789	1,235	483.3	30.8	322.6	229.2
Appalachian:														
District 1	108	50.4	3.1	24.9	8.6	4,627	598	3,513	577	102	45.3	2.5	22.3	4.8
District 2	113	57.0	3.1	23.3	10.9	2,332	594	1,319	197	48	26.8	2.4	6.8	7.1
Ind., Ill., Ky.	1,390	706.0	54.1	284.4	165.1	30,457	7,074	24,437	5,860	1,271	662.9	53.8	254.2	139.9
Minn., Wis., Dak.	58	21.4	1.6	16.1	7.9	5,494	1,670	8,173	476	104	48.7	5,6	30.2	8.2
Okla., Kans., Mo.	705	414.9	16.3	164.2	33.9	13,860	1,919	14,154	1,093	728	405.0	11.8	160.3	28.1
Inland Texas	269	216.1	8.6	57.9	21.7	6,675	551	2,899	1,968	278	212.3	8.5	49.6	20.6
Texas Gulf Coast	1,927	982.2	86.4	484.2	226.1	24,236	3,890	19,906	7,860	1,854	904.1	77.6	471.7	241.6
La. Gulf Coast	607	363.4	46.3	148.0	40.1	10,923	3,453	8,795	1,753	668	361.1	45.5	169.0	45.3
N. La. and Ark.	98	38.9	7.3	22.4	6.9	4,502	797	2,323	201	97	34.7	5.6	22.4	6.7
Rocky Mountain:														
New Mexico	28	14.1	0.9	5.7	3.3	412	10	116	69	26	13.7	0.1	6.2	2.3
Other Rocky Mtn.	293	133.0	2.6	64.0	35.4	5,417	350	3,237	944	285	134.1	2.1	61.4	34.6
West Coast	1,094	476.7	1.9	148.4	335.8	25,583	410	17,613	23,316	1,156	500.5	2.7	172.9	321.2
Oct. 4, 1957	7,779	3,970.4	235.9	1,757.9	1,094.1	177,383	35,775	171,291	58,103	7,852	3,832.5	249.0	1,749.6	1,089.6
Sept. 27, 1957	7,918	4,061.1	224.6	1,755.4	1,132.7	177,430	36,331	169,265	57,716	.....	.....	.....	.....	.....
Oct. 5, 1956	7,697	3,812.4	299.4	1,895.4	1,102.6	176,000	33,243	151,805	47,299	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (89 octane)	11.50-11.75
Premium (98 octane)	14.25-14.50
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.00-11.50
Regular (92 octane)	11.25-11.75
Premium (97 octane)	12.75-13.25
Premium (98 octane)	13.00-13.50
California (rack):	
Regular (88 octane)	12.9
Premium (96 octane)	14.9
Premium (98 octane)	15.4
Caribbean area (cargoes):	
Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.50-10.00
Diesel oil (58 d.i. and above)	9.125-9.75
Distillate No. 1	9.125-9.75
Distillate No. 2	8.50-9.00
Gulf Coast (cargoes):	
Kerosine 41-43	8.75-9.50
Distillate No. 2	8.75-9.50
New York Harbor (barges):	
Kerosine 41-43	10.75
Distillate No. 2	10.25
Diesel fuel, 48-52 d.i.	10.55
Caribbean area (cargoes):	
Distillate No. 2	9.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
★Residual fuel (max. 1% S)	$1.65-1.85
Gulf Coast (cargoes):	
Bunker C fuel	$2.50-2.75
New York Harbor (barges):	
Bunker C fuel	$2.95
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour) (§)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour. §Ohio Oil Co. is posting 8 cents less up through 26.9° gravity.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, July 26, 1957.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.65
Middle District	4.47
Southwest Pennsylvania	4.18
West Virginia	4.00
Buckeye Grade	4.00
Zanesville Grade	3.04
Illinois Basin	3.15
Canada:	
Leduc-Woodbend	2.74
Redwater (Alta)	2.63
Smiley (Sask.)	2.40
Pembina	2.61

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 36.0°-36.9°, Fao	2.00
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 41.0°-41.9°, Umm Said	2.23
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.59
Iraq, 36.0°-36.9°, Tripoli, Banias	2.59
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

★Gulf-U.S.N.H., dirty (USMC—25%)	$2.14
★Carib.-U.K., dirty (Scale—45%) (17s. 11d.)	2.51
All options, dirty (Scale—50%)	....
★Calif.-Japan, clean (USMC—65%)	2.66

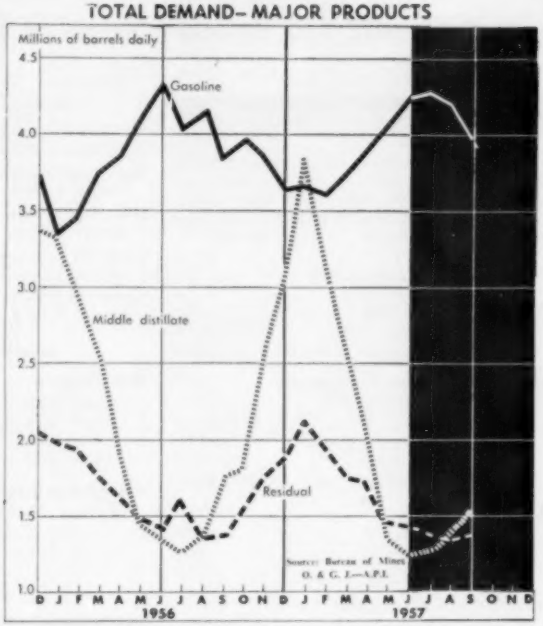
SUPPLY AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels)

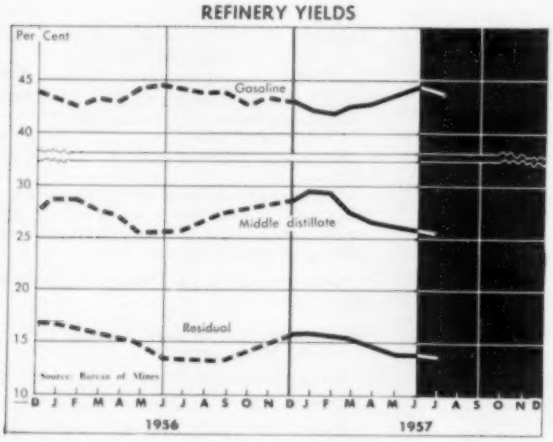
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
September 1957*	3,975	3,070	177,400
August 1957*	4,200	4,000	171,000
July 1957	4,286	3,832	177,868
October 1956	3,970	3,727	172,798
September 1956	3,860	3,902	177,974
KEROSINE			
September 1957*	220	275	36,000
August 1957*	175	270	34,200
July 1957	162	249	31,713
October 1956	294	356	35,667
September 1956	274	329	33,588
DISTILLATE			
September 1957*	1,310	1,770	170,425
August 1957*	1,230	1,790	155,500
July 1957	1,095	1,750	138,359
October 1956	1,521	1,772	158,871
September 1956	1,447	1,845	150,411
RESIDUAL			
September 1957*	1,380	1,125	57,950
August 1957*	1,340	1,100	52,600
July 1957	1,334	1,100	49,621
October 1956	1,532	1,082	48,400
September 1956	1,384	1,062	47,342

*Preliminary. †Thousands of barrels.

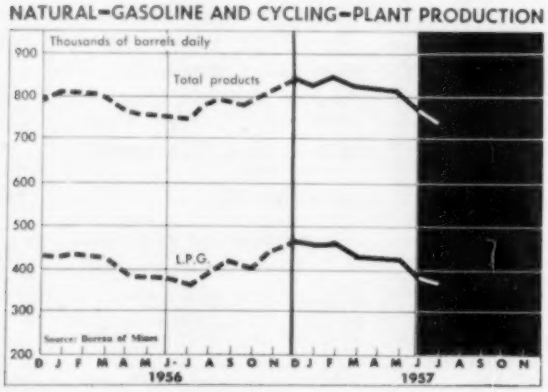
TOTAL DEMAND—MAJOR PRODUCTS



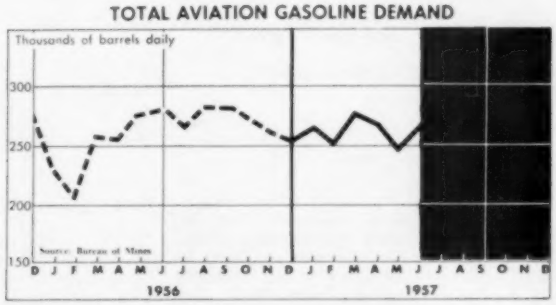
REFINERY YIELDS



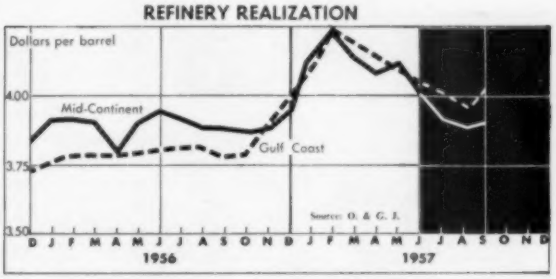
NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



TOTAL AVIATION GASOLINE DEMAND



REFINERY REALIZATION



REFINERY REALIZATION

	Sept.* 1957	August* 1957	July 1957	Sept 1956
Mid-Continent	$3.92	$3.88	$3.86	$3.88
Gulf Coast	4.03	3.97	4.01	3.78

*Preliminary.

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S. H. ROURKE,
Business Manager.

Sworn to and subscribed before me this 30th day of September, 1957.

ROBERT D. FUNK,
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LEGAL

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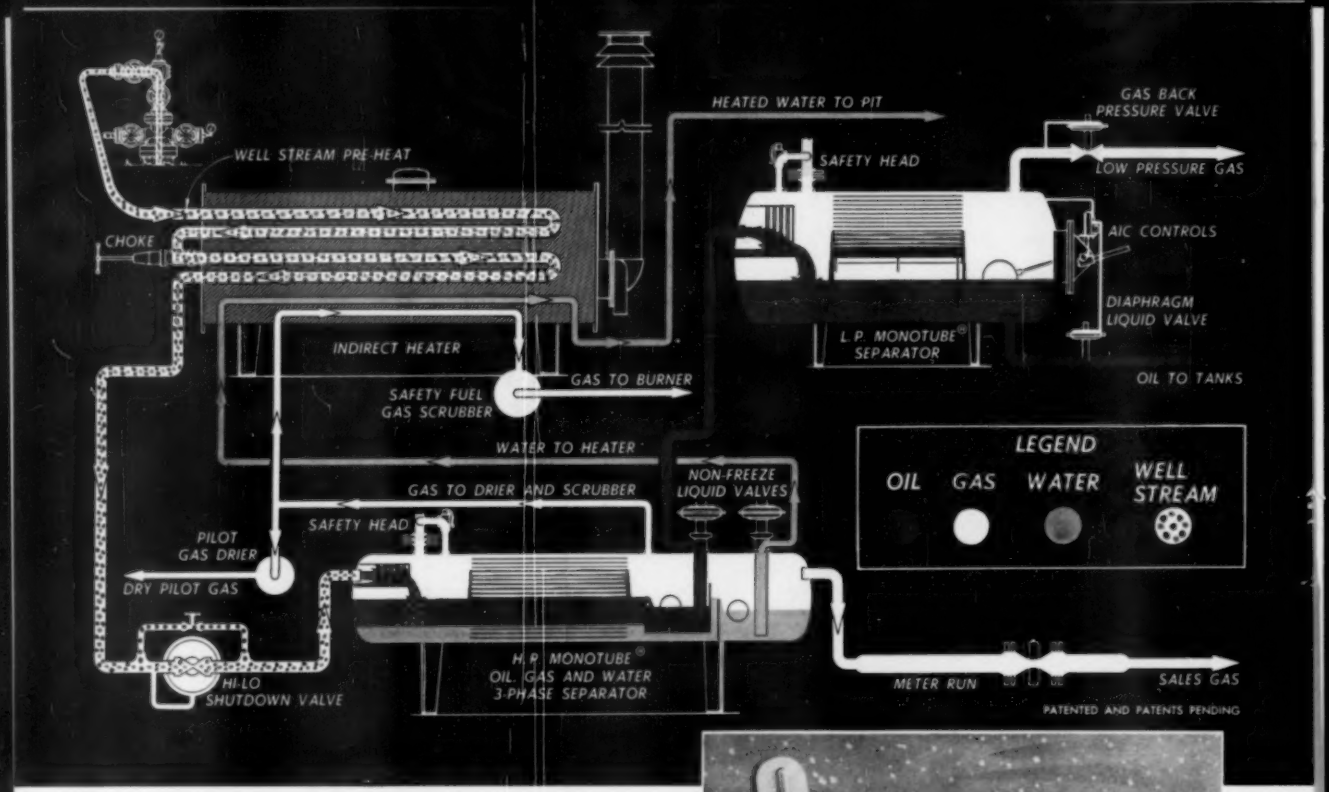

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   Also, Hughes has two copyrighted hydraulic bulletins that can aid you in getting the most out of your present equipment and in the selection of new equipment.

3. **Continuous drilling research** . . . carried on in the laboratory and field for nearly a half century. Facts obtained in the laboratory and field are used in developing new and improved rock bit designs and in anticipating the problems created by changing drilling techniques.

4. **Industrywide organization** and system for gathering information and forecasting bit requirements for each drilling area. This assures you that no matter where you drill, Hughes bits of the right sizes and types will be available to meet your particular drilling requirements.

WHEN YOU RELY ON HUGHES YOU TAKE THE GUESSWORK OUT OF BIT SELECTION